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BOMBAY BRANCH

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to extend popular interest in Indian meteorology, and inculcate a rational conception of the aims and methods of the science.

OBSERVATORIES AND THEIR EQUIPMENT.

In the report for 1875-76, I gave a list of the stations sanctioned under the Meteorological Department; and also of those which are independent of the Department, but which contribute registers for discussion and publication in the annual report. In the former list, twenty-two were distinguished (in italics) as new stations, three only of which (Chikalda, Peshawar and Sirsa) had been equipped before the 31st March 1876. Of the seven Burmese stations, enumerated as already established, three only were furnished with verified instruments and working on the authorized system, *viz.*, Rangoon, Akyab and Moulmein.

Up to the 31st March 1877 the following additional stations have been provided with sets of verified instruments and brought into working order from the dates specified in each case:—

In Rajputana	Mount Abu	1st May	1876.
„ Central India	Indore	25th February	1877.
	Neemuch	3rd March	„
„ Baghalkand	Sutna	1st July	1876.
„ the Central Provinces	Sironcha	2nd April	„
„ Bombay	Bhuj	1st December	„
	Rutnagiri	1st January	1877.
	Sholapore	2nd „	„
	Jacobabad	1st February	„
„ Burmah	Bassein	1st January	„

There remained therefore, still awaiting their equipment, the following stations; of which, three, *viz.*, Malegaon, Surat and Hyderabad, have been since established. Shidashagur in the Concan, and Jessulmere in Rajputana, are omitted, as it has been resolved to relinquish them as meteorological stations:—

In Bombay	Surat; Hyderabad; Rajkot; Malegaon;
„ Madras	Mangalore;
„ Burmah	Thyetmyo; Tounghoo; Mergui; Mandalay; Bhamo;

and the following observatory, which was working on the 31st March 1876, has since been suppressed:—

In Madras ... Kurnool.

As far as I can learn from the registers communicated to my office, the two second class stations sanctioned for Madras, *viz.*, Bellary and Trichinopoly, still remain working on the old system. All other second class stations are now fully at work.

In addition to the new stations sanctioned under the re-organization scheme, there have been some other important additions to the system. At Leh, where an observatory was established by the Government Agent in Ladák, hourly observations have been recorded on the same system as at the second class stations. The Resident at Bushire on the Persian Gulf, Colonel Ross, (for whom Colonel Prideaux has been officiating during the greater part of last year), having been supplied with verified instruments, has contributed a regular register, on the system of third class stations, since April 1876; and the Principal of the Mayo College at Nowgong, in Bundelkand, was furnished with a similar set of instruments in November 1876; but they were not brought into use

until within the last few weeks (4th June). Also, in February last, on the application of Major Sandeman, Political Agent in Khelat, an observatory has been sanctioned in Bálúchistán; a medical subordinate has been trained as observer, and instruments, duly verified, have beeen lately supplied for the purpose. In a communication lately received from Dr. Duke, the Medical Officer to the Bálúchistán Agency, Shawlkót, is recommended for the future observatory; and meanwhile, some very interesting camp registers have been received from Khelat, Quetta, Mitree and some other places, which shew a climate with a remarkable diurnal range of temperature, in this respect apparently surpassing that of the Punjab.

The system of meteorological registration, under the Indian Government, extends therefore, at the present time, from 51° to 94½° east longitude (a range of 43½°), and from 10° to 34° north latitude, or over a belt of 24°. By including Ceylon, the breadth of the region brought under discussion is extended to 28°.

The following is a more detailed notice of certain of the observatories:—

The Calcutta Observatory.—The completion of the observatory at Alipore (a suburb of Calcutta) has, for the first time, put the Meteorological Department in a position to train observers, verify instruments, and to obtain several kinds of observations which were much required for the purpose of scientific enquiry. Not the least important change in the system, is the substitution of a continuous registration of some of the more important meteorological elements, for the hourly eye observations, which have been carried on at the Surveyor General's Office for twenty-four years; and it is intended to extend the system of observation so as to include, among other subjects, the temperature and humidity of the atmosphere at a considerable height above the ground, the temperature of the ground at different depths, sub-soil-air analyses (for the Cholera Commissioners), the registration of earthquake phenomenon, &c., together with comparative experiments on the exposure of instruments, the validity of certain methods of observation, &c., and also, as a distinct branch of work, the determination of the time for the town and port.

The observatory is a small ornamental building, designed and erected by Mr. S. A. Stewart, C. E.* It is situated on a plot of ground to the south of the Zoological Garden at Alipore, which has hitherto formed part of the grounds of the Military Orphan Asylum. There are no loftier objects in the immediate neighbourhood, excepting two palm trees in front of the building and a few *Gualterias* and *Casuarinas* to the south, at such a distance that they can hardly affect the anemometer. The building was completed in the beginning of 1877, and the self-registering thermograph, barograph and anemograph, which were procured nearly three years ago, were set up and partly in operation before the end of the year under review. The two former instruments are similar to those in use at Kew, and register a continuous photographic trace on a sheet of waxed paper, sensitized with Brome-iodide of silver; the recording light being afforded, either by a kerosene lamp or a gas jet. The photographic process adopted at the Alipore observatory is almost identical with that followed at Kew. On two occasions, when in England, I obtained permission to visit the Kew observatory and to witness the process as there practised; and I desire to express my indebtedness to the Meteorological Committee of the Royal Society and to the Director of the Meteorological Department of Great Britain for their ready compliance with my application for this assistance; an assistance which, it is well known, is always readily and cordially accorded to all applicants having objects similar to mine. I have also to express my thanks to the Officiating Superintendent of the Colaba Observatory for similar assistance afforded, at my request, to Mr. Eliot, the Meteorological Reporter for Bengal. Having been informed some time since by the Superintendent, Mr. C. Chambers, that he had not found the Kew process successful at Bombay, and had modified it to suit the conditions of the climate, I applied to him for information respecting the changes he had found necessary; and, in December last, his brother, then officiating for him, allowed Mr. J. Eliot to witness the process and to take such notes as he required. When, however. the instruments were set up at

* In justice to the architect, I should mention that the erection of certain meteorological instruments on the ornamental turrets of the building has somewhat detracted from its æsthetic character.

Alipore, Mr. Eliot was absent on leave, and Mr. A. Pedler was officiating for him. It was resolved, therefore, in the first instance, to try the unmodified Kew process, as I had seen it practised at Kew, and Mr. Pedler's experience in photographic manipulation having enabled him to supply what was wanting on my part, we have succeeded in working the Kew process in a satisfactory manner, so that it has not been necessary to avail ourselves of Mr. Chambers' kind assistance. All the autographic instruments of the observatory, except the rain-gauge, are now at work, but some time must elapse before the photographic traces can be fully utilized; since, the scales being arbitrary and indeed variable, according to the setting of the instrument, it is necessary to find out their value by a lengthened comparison of the traces with the readings of standard instruments, after the parts of the instrument have been finally adjusted. The traces have already furnished important information; the barograms, more especially, showing the very remarkable oscillations of pressure, that accompany nor'wester storms and similar local atmospheric disturbances.

A room with double walls was built specially for the barograph, with the object of preserving the instrument from rapid changes of temperature, and has proved a complete success. In April and May, when the range of temperature of the external air frequently exceeded 20°, that of the mercury of the barograph did not amount to 1°, and that of the air of the room was less than 2°.

As far as experience has yet gone, the thermograph seems to show the true range of air temperature, within one or two degrees at the utmost; but as the instrument is, of necessity, less freely exposed than the hygrometer placed under the thermometer-shed of the usual pattern, the wet bulb temperatures, during the present hot season, have been much higher than those of the smaller instrument under the shed; and from what I have seen of the extreme sensitiveness of the wet bulb to small variations of exposure, I am doubtful whether the self-registering instrument can ever be made a complete substitute for that which is read by eye; unless, perhaps, by adopting some artificial method of fanning the bulb. It will, however, probably be possible to obtain corrections from the readings of the smaller and more exposed instrument, which, applied to those of the thermograph trace, will enable the latter to be reduced to terms of the former. The thermograph is placed in the main building of the observatory; a small room to the north of the building, from which light is usually excluded, being devoted to the recording apparatus; while the thermometer bulbs, at the end of long horizontal tubes, protrude through a screen, and are exposed outside the building, under the roomy louvred shed, double at the sides and top. The lower part of the shed is not enclosed, but furnished with an open railing only.

The anemograph, on Beckley's principle, is erected on the north-west turret of the observatory, 53 feet above the ground. The dimensions of the cups and revolving frame are the same as those of the anemograph of the Kew observatory; the former, *viz.*, 9 inches in diameter, the latter 2 feet in length from the centre of the cup to the centre of the axis. The instrument has been working, for the last three years, on the roof of the Meteorological Office in Chowringee; but the present site is much better.

The self-registering rain-gauge has lately been set up on the south-east turret of the observatory, the funnel being a foot or two lower than the anemometer frame; and the registering apparatus is in the small turret room below.

The present work of the observatory consists of readings of the standard barometer and wet and dry bulb thermometers (under a shed of the usual pattern) five times daily, *viz.*, at 6h., 10h., 16h., 18h. 36 m.,* and 22h., with the usual observations on the state of the sky and atmosphere, the weather, cloud proportion and movement, &c., the maximum dry and minimum dry and wet bulb thermometers. The solar radiation and nocturnal radiation thermometers are read each once daily; and the rain-gauge as often as rain falls. The standard thermometers in the thermograph shed, and the standard barometer, are also read at the even hours 6h., 8h., 10h., &c., during the daytime, for the purpose of obtaining the values of the photographic traces. The temperature of the mercury of the barograph is taken four times daily, together with the maximum and minimum temperatures of the air of the barograph room.

* This is synchronous with 7h. 35m. A. M., Washington time, and is the contribution of Calcutta to the system of synoptic observations established over a great part of the Northern Hemisphere, by the exertions of General Albert J. Meyer, Chief Signal Officer of the United States' Army. Similar observations are now recorded at all 1st and 2nd class stations in India.

In addition to these, there is the work connected with the self-recording instruments, the photographic preparation and development of the traces, and the tabulation of the anemograph trace, which records the hourly movement and direction of the wind.

Arrangements are now being made to obtain observations of the temperature and humidity of the air about 40 feet above the ground. For this purpose, one of the three *Tál* palms, which grew in front of the observatory, has been lopped, the crown and some 14 feet of the soft and sappy stem removed, and an iron cap with guys of wire rope, fitted to the stump. A platform and ladder will shortly be added. At the top will be fixed a cage, which will be protected from the sun by a double roof, the outer one of tin plate (which may be renewed from time to time); and in the cage will be placed the thermometers.

Other work performed by the observatory establishment, is the verification of the instruments for use at the Government observatories in Bengal, the North-Western and Central Provinces, the Punjab, and Burmah. A few instruments have also been verified for officers of other departments; but the establishment is, at present, too small to undertake much work of this kind. The present establishment consists of a photographic assistant and computer on Rupees 40 and two observers on Rupees 20 each; their work being under the daily supervision of the Meteorological Reporter for Bengal, and myself. The Observatory Superintendent, on Rupees 200 and two assistants on Rupees 40 and Rupees 30, respectively, with a menial establishment at Rupees 38, being retained at the Surveyor General's Office to take the daily transit and meteorological observations at 10 A. M. and 4 P. M., to rate the chronometers and drop the time-ball. A transit room is, however, to be erected at Alipore; and, when this is finished, the Surveyor General's Department will be relieved of these duties, and the observatory establishment will be completed.

Up to the present time, three observers have been trained for employment in the mofussil, and it is intended that, as far as circumstances will admit, all persons to be employed as observers shall, in future, receive a similar training. Only by such means can we hope to surmount the inconveniences hitherto experienced at many important stations, owing to the ignorance of the observers.

Other observatories in Bengal and Assam.—There has been no change in the number of observatories, or the methods of observation pursued. But all those thermometers which had not previously been verified, have been recalled, and replaced by verified instruments; and the former, having since been compared with the office standard, all the past observations made with these instruments can now be (and those for 1876 have been) corrected and rendered as far as possible rigorously comparable with each other.

There are, under the Meteorological Reporter to the Government of Bengal, eight stations of the second class, *viz.*, six in Bengal and two in Assam. At these, (with the exception of Saugor Island and False Point,) in addition to the daily observations at 10 A. M. and 4 P. M., hourly observations are recorded from midnight to midnight on four days in each month. Mr. Eliot reports that "these stations are now all in satisfactory order, and, as far as can be ascertained, the observations are made with great care and attention, and accurate results are obtained. At the beginning of the year there was some difficulty with one station, Chittagong, but latterly the returns have been submitted with great regularity. It is satisfactory to report that the Electric Telegraph Master, Mr. Burke, who is observer at this station, took a most valuable series of observations, at short intervals, during the cyclone of the 31st October last, at considerable personal inconvenience and even risk."

At the ten stations of third class, (including the independent observatory of Durbhanga,) Mr. Eliot reports that "the work is not conducted so satisfactorily as at the second class stations; and with reference to two or three of the observers, the complaints have been serious. Most of the stations, however, sent in records which are fairly accurate, and which are received with regularity; but the observers at Jessore, Durbhunga and Gya have been very troublesome, forwarding inaccurate returns at irregular intervals. If the observers at these stations fail to improve, they will be replaced by men who have received their training at the Alipore observatory."

The following is a list of the second and third class stations with the names of the Superintendents and Observers:—

Stations.	Superintendents.	Observers.
Sibsagar ...	Dr. M. Mookerjee ...	Dundadhar Dutta Barua.
	Hospital Assistant Bhokot Ram Dutt.	An assistant observer.
	Dr. R. C. Sen ...	
Goalpara ...	Dr. J. P. Cromarty ...	Muniruddin Ahmed.
		An assistant observer.
Darjeeling ...	... ...	Mr. J. Blong.
Purneah ..	Dr. W. D. Comins ...	Himat Ali.
	Dr. D. Picachy ...	Baboo Kunund Behari Samanta.
Patna ...	Dr. B Simpson ...	Moonshee Mohabat Lall.
	Assistant Surgeon Dyal Chand Some.	An assistant observer.
Durbhunga ...	Dr. J. C. McDonnell.	
Gya ...	Dr. R. McLeod ...	Nowrungee Lall.
Hazaribagh ...	Dr. E. Birch ...	Raheemoollah.
		An assistant observer.
Berhampore ...	Dr. S. M. Shircore ...	Baboo Mohendranath Roy.
Burdwan ...	Dr. C. H. Joubert ...	Baboo Mokhodaprasad Chowdry.
	Dr. R. L. Dutt ...	
Jessore ...	Dr. W. H. Gregg ...	Baboo Dwarknath Roy.
	Dr. R. T. Wright ...	
Dacca ...	... ...	Mr. J. Collet.
Silchar ...	Dr. J. J. Monteath ...	Baboo Rameshchundra Bhadra.
Chittagong ...	... ...	Mr. C. Debuan.
		Mr. J. Burke.
		An assistant observer.
Saugor Island ...	... ...	Mr. R. H. Peters.
Cuttack ...	... ...	Mr. A. N. Perry.
		Mr. J. C. Smith.
		An assistant observer.
False Point ...	... ...	Mr. T. Geary.
Akyab ...	... ...	Mr. T. J. Bennett.

Rain-fall returns, kept under the superintendence of the civil officers, are sent in from 164 stations; of which 150 are in Bengal and 14 in Assam. Three registers are also regularly communicated by private observers, *viz.*, Dr. Foster of Nazira in Assam, Mr. J. C. Vertennes of Balasore, and Mr. J. M. L. Thompson of Contai.

Mr. Eliot has visited the Gya observatory during the year under report; and the observatories of Purneah and Berhampore were inspected by myself, and found to be in satisfactory condition.

Observatories in the North-Western Provinces and Oudh.—In 1875-76 there were thirteen Government observatories at work under the direction of the Meteorological Reporter for the North-Western Provinces, and two, *viz.*, those at Meerut and Dehra, under independent management, but which furnish registers. An additional Government observatory was established during the past year at Sutna, in Baghalkund, and began work on the 1st July 1876. And another station under independent management, Nowgong in Bundelkund, was supplied with instruments; although work was not commenced until two months after the close of the year under report.

Allahabad, which has been sanctioned as a first class station, (with autographic instruments,) has continued to work as a second class station, the observatory being retained at the private dwelling-house of the Meteorological Reporter. Preparations are being made to provide special accommodation for the future observatory in connection with the Thornhill Memorial in the Public Garden,* and the instruments (Van Rysselherghe's meteorographs) are now being manufactured by T. Schubert of Ostende, and may be expected, perhaps, during the present year. In one respect, the observations recorded at Allahabad are more

* This has lately been sanctioned by Government at a cost of Rs. 16,400.

numerous than those of the other second class observatories in the province. They include the readings of the principal instruments at 4 A. M. and 10 P. M., as well as those of 10 A. M. and 4 P. M., and the hourly observations on four days in each month.

The following is a list of the observatories of all classes in the North-Western Provinces, in operation on the 31st March 1877, together with the names of the Superintendents and Observers during the past year :—

Stations.	Superintendents.	Observers.
Ajmir ...	Dr. T. Murray ... / Dr. Newman* ...	Ramprashad.
Chakrata ...	J. Bromley, C. E.† ... / Captain Spratt, R. E. ...	Saligram.
Dehra Dun ...	Officers of the G. T. Survey.	
Roorkee ...	Dr. Murray Thomson ...	Chiranghi Lal. / An assistant.
Ranikhet ...	*No Superintendent* ...	Jewamund. / Gunga Dutt.‡
Meerut ...	Dr. Moir ... / Dr. Harris§ ...	Kursorun Dass.
Bareilly ...	P. M. Biswas ... / Mr. G. S. Stack ... / Mr. E. S. Phillips ...	Dabipershad. / Jwalapershad.
Agra ...	Dr. Hilson ...	Mir Altaf Ali. / An assistant.
Lucknow ...	Dr. Bonavia ... / Dr. MacReddie‖ ... / Dr. Franklin¶ ...	Chetay Lal. / An assistant.
Sutna ...	Dr. S. J. Goldsmith ...	Hernauth.
Gorakhpur ...	Dr. Wood** ...	Mahamed Shyek.
Jhansi ...	Dr. O'Brien ...	Kalka Dass.
Allahabad ...	Mr. S. A. Hill ...	Narain Pershad. / Choonie Lal. / Kedarnath Chatterjee.
Benares ...	Mr. R. T. H. Griffith†† ... / Mr. Gough ...	Lukshmi Sunker Misra. / Devakinandun Pattack.

* Officiating for a short time.
† From September 1876.
‡ From 21st December 1876 to 8th January 1877.
§ Officiated from 9th April to 16th December 1876.
‖ In May 1876.
¶ In June 1876.
** From 15th May.
†† Officiated at intervals.

Mr. Hill reports that "of the returns received from the fourteen stations (with apparently two exceptions, presently to be mentioned), the following are quite trustworthy, *viz.*, those of Dehra, Roorkee, Bareilly, Agra, Lucknow, Allahabad, Benares and Sutna. Somewhat less valuable are the registers from Chakrata, Gorakhpur and Ajmir; while in those from Meerut, Jhansi, and Ranikhet, where the barometers have been kept outside in the thermometer sheds, the apparent daily range of pressure must be wide of the truth." To this I may add, that the instruments in use at Meerut and Jhansi, (which have now been replaced by others,) were slow in action, and therefore unfitted in any case for shewing the diurnal variation; while that at Ranikhet, during a part of the year, was so suspended, that it could not be properly read and adjusted. Mr. Hill further remarks that at Agra and Allahabad the exposure of the thermometers was unsatisfactory. In this I agree with him; the instruments at Agra were too much enclosed, and at Allahabad not sufficiently protected from the glare of the sun.

It is satisfactory to learn, that, in Mr. Hill's opinion, the observers appear to perform their work honestly; less so, that one or two of them are not so intelligent as might be desired. But this can hardly be avoided under the system, which obliges us to employ as observers certain persons who already fill particular posts at the stations selected.

Mr. Hill has visited and inspected eight stations during the past year, *viz.*, Chakrata, Ranikhet, Dehra, Roorkee, Bareilly, Agra, Benares and Sutna.

That portion of his report which describes the condition of the observatories is given in Appendix I. I accompanied him on a portion of his tour in December last, visiting Roorkee, Dehra and Chakrata; and afterwards visited by myself, Ranikhet, Bareilly, Lucknow and Benares, all of which (except the first,) were in a very satisfactory state. Ranikhet is now much improved.

It will be observed in the extract from Mr. Hill's report, quoted in the Appendix, that he has met with some difficulty in finding officers willing to undertake the superintendence of observatories. I have reason to believe that such cases are quite exceptional; and the difficulty might have been altogether avoided if, when the system was first established, steps had been taken, in the first place, to select proper sites for the observatories, and, next, to obtain the orders of Government making the office of Superintendent an *ex-officio* duty of some Government officer. The work attaching to that office, especially at third class stations, when they have once been brought into good working order, is little more than nominal; but it is very necessary that instructions should be conveyed to the observer through the officer who is in other duties his official superior. The above course was adopted in Bengal and Madras; and in neither case has any difficulty been encountered, beyond this, that all officers are not equally active and interested in the work. As a very general rule, however, with rare exceptions, they take upon themselves, willingly, whatever trouble may be necessary to keep the work up to a good standard; and the present condition of the large majority of the observatories testifies to the success of their labours.

The thermometers of all kinds in use at the observatories of the North-Western Provinces and Oudh, have been called in during the past year and verified; other instruments, previously verified, having been issued to replace them.

Observatories in the Punjab.—There have been no changes in the observatories of the Punjab during the last year, the two new stations, Sirsa and Peshawar, having been established in the earlier months of 1876.

It is intended to make Lahore a first class observatory, with autographic instruments, and the instruments (Van Rysselberghe's meteorograph) have been for some months in course of manufacture, and, as already mentioned, may be expected about the end of the current year. But no provision has yet been made for any building fitted for their reception, there being no funds available for the purpose; so that there does not seem to be any present prospect of their being brought into use *a*; meanwhile, the Lahore observatory is carried on as one of the second class, with the addition of observations at 10 P.M. and 4 A.M., as at Allahabad.

There is no other second class station in this province, but Leh, in the Cashmir territory, works as a second class station, and communicates its registers to the Meteorological Reporter for the Punjab.

The following is a list of the stations and a nominal list of the Superintendents and Observers during the year under report:—

Stations.	Superintendents.	Observers.
Leh	Mr. R. B. Shaw	Chirag Din. Bhola *(Assistant)*.
Peshawar ...	Dr. W. Courtney	Kashi Ram.
Murree ...	The Rev. G. C. Peak ...	W. Sinclair. * Sergeant Sooper. † Mr. R. Johnson. ‡
Rawal Pindi ...	Dr. Ince § ... Dr. G. Henderson ‖ ...	Bhawani Dass.
Sialkot ...	Dr. McKeller ¶ ... Dr. R. Cunningham ** ...	Fatteh Singh.

* To 8th October 1876.
† From 8th to 31st October.
‡ Since 31st October 1876.
§ To 31st December 1876.
‖ Since 31st December 1876.
¶ To 28th February 1877.
** Since 28th February 1877.

a Since the above was written, I have received the assurance of the Lieutenant-Governor, the Hon'ble Mr. Egerton, that the provision of an observatory shall have the speedy attention of the Government.

Stations.	Superintendents.	Observers.
Lahore ...	Dr A. Neil ...	Jasput Rai.
		Divan Chand *(Assistant)*.
Ludhiana ...	Dr. Rouse ...	Amir Beg.
Simla	Officers of the Q. M. Genl.'s Dept.	
Delhi	Radha Kishen ...	Radha Kishen.
Dera Ismail Khan ...	Dr. J. Duke ...	Noor Baksh.
Mooltan ...	Dr. R. Gray * ...	Vahid Ally Shah.
	Dr. J. C. Penny † ...	
Sirsa	Dr. J. Rebill ‡ ...	Fazall Rahman. ‖
	Bawah Matab Singh § ...	Sham Soondar. ¶

* To 15th December 1876.
† From 13th December 1876.
‡ To 23rd June and since 11th September 1876.
§ From 23rd June to 11th September 1876.
‖ To 2nd November 1876 and since 22nd January 1877.
¶ From 2nd November 1876 to 22nd January 1877.

Dr. Neil reports that the most carefully-kept registers [a] are those of Lahore, Delhi, Ludhiana, Sirsa, Rawalpindi, Sialkot, Peshawar and Murree; also, that the registers of Mooltan have frequently been returned on account of their inaccuracies.

The thermometers in use at all the observatories, (excepting the few that had been compared before being issued, and those in use at Simla,) have been recalled for comparison and replaced by verified instruments.

None of the Punjab observatories have been visited by Dr. Neil during the year under report. My own last tour of inspection in the Punjab was brought to a close just at the beginning of the year, when I visited Lahore, Sialkot, Rawalpindi and Delhi. Dr. Neil also sent a trained assistant with the new instruments supplied to most of the stations, to see that they were properly exposed and registered.

Observatories in Bombay, Rajputana, Central India and Berar.—At the beginning of the year under report, the only observatories in these provinces were the Colaba observatory and the four old established stations, Kurrachee, Deesa, Poona and Belgaum; Ajmir, which had been at work for many years under the Reporter for the North-Western Provinces; and the four stations in Berar, three of which were established some years since by Dr. Abbott. Up nearly to the end of 1876, no addition was made to this list, excepting Mount Abu, where a small observatory, having no connection with the Meteorological Department, was in existence at the time of Mr. F. Chambers' visit. By making one or two changes in the equipment of instruments, it was brought into a condition to furnish registers from the beginning of May 1876. The only other station under Mr. F. Chambers, which has furnished registers for any part of 1876, is Bhuj, for the month of December only. Between the 1st January and the 31st March 1877, three more stations in Bombay, *viz.*, Ratnagiri, Sholapur and Jacobabad, and two, *viz.*, Indore and Neemuch, in Central India, were added to the list; and three others, *viz.*, Malegaon, Surat and Hyderabad, have since been established. For the whole of 1876, therefore, the meteorology of these provinces is scarcely better represented than in 1875, but it is hoped that there will be a considerable improvement during the year now current.

The instruments furnished to the above stations have been sent from Calcutta and verified in Bombay.

The observers for Sholapur, Surat, Bhuj, Rajkot, Malegaon and Deesa have been trained at the Bombay Meteorological Office. In the case of Mount Abu, Neemuch, Indore, Akola, Amraoti and Chikalda, Mr. Chambers reports that at the time of visiting these stations he put the observers through a similar course of training. Those of Jacobabad and Hyderabad have been taught by the observer at Kurrachee, and the man at Rutnagiri by the Civil Surgeon, Dr. C. Joynt.

Mr. Chambers further reports, and I have much satisfaction in endorsing his statement, that the Department is much indebted to the Surgeons-General, both of the Indian and British Medical Departments for the cordial assistance

[a] Omitting Simla, which is an independent observatory attached to the Quartermaster General's Office, the observations being recorded by a military officer of the department.

they have given by allowing Hospital Assistants to be made available as observers, and by sending them to Bombay to be properly trained for the work.

A nominal list of the Superintendents and Observers at the several observatories which were at work during the year under report, has not been received up to the time of going to press.

Mr. Chambers reports that the registers from the stations Belgaum, Poona, Deesa, Abu, Kurrachee, Akola and Amraoti are on the whole satisfactory. Those of Chikalda and Buldana less satisfactory; but that there was a decided improvement at both stations in December. There have been several breaks in the continuity of the observations at Belgaum, and one at Deesa, owing to the illness of the observers; but, with these exceptions, the registers have suffered no interruption at any of the stations.

The elevations of the newly established stations have not yet been reported. That given for Belgaum in the Meteorological Report for 1875 was seriously erroneous. It was the result of an old determination of the Great Trigonometrical Survey, made in the earlier days of the Survey. The new determination, for which I am indebted to Colonel Walker, shews a difference of about 100 feet. As this correction makes a difference of about a tenth of an inch in the deduced values of the barometric readings at sea-level, it necessitates a corresponding alteration in the table and charts given in the report for 1875, and proves that the excessive pressure, apparently shewn by Belgaum in that year was really illusory.

I reproduce, in Appendix II, some extracts from Mr. Chambers' reports, giving a more detailed description of the observatories and the condition in which he has found them.

Observatories in the Central Provinces.—One observatory has been added to those previously established by Dr. Townshend, *viz.*, Sironcha, by which the network of observatories is advanced one step further into the little-known country around the Lower Godavari, which makes a large unrepresented gap in the meteorological charts. Of the older stations, three second class observatories, Nagpur, Jubbulpore and Pachmarhi, have done very satisfactory work; and the more accessible of the third class stations, Khandwa and Hoshangabad, for instance, and I may add Raipur, have been also satisfactory; but the registers of Seoni, Sambalpur and Chanda have been far from satisfactory, owing, I regret to say, to the apathetic neglect, by the observers, of the definite instructions drawn up and printed for their guidance.

In the case of these three stations, a part of the barometric registers have had to be rejected on this account.

All the thermometers, formerly in use at the stations in the Central Provinces, have been recalled for verification at Calcutta, and instruments, previously verified, have been substituted for them.

The following is a list of the stations with the names of the Superintending Officers and Observers:—

Stations.	Superintendents.	Observers.
Nagpur	Surgeon-Major J. Barter ...	T. V. Vurtharajooloo.
	,, ,, J. Law[1] ...	T. V. Allagheriswamy (*Assistant*).
Jubbulpore	,, ,, W. R. Rice ...	Goray Lall.
Pachmarhi	Captain H. H. Hallet ...	Bhicajee Ballab Damle[3].
	H. J. A. Jeffreys, C.S. ...	Madho Rao[4].
	Captain F. B. Morris ...	Narain Bhugwant Wagley (*Assistant.*)
Saugor	Surgeon D. F. Bateman ...	Deen Dyal.
Hoshangabad	Surgeon-Major J. M. Fleming[5] ...	Abdul Ghafur Khan[8].
	,, ,, J. J. Heffernan[6] ...	Vasudeva Prashad Narayan[9].
	,, ,, K. M. Leckler[7] ...	

[1] Officiating from 7th February to 8th March 1877.
[2] Since 12th December 1876.
[3] To 1st November 1876.
[4] Since 2nd November 1876.
[5] To 14th November 1876.
[6] From 15th November to 3rd December 1876.
[7] Since 4th December 1876.
[8] To 10th April 1876.
[9] Since 11th April 1876.

Stations.	Superintendents.	Observers.
Khandwa ...	Surgeon-Major P. Cullen ...	Raja Ram.
Seoni ...	Surgeon B. Evers[1] ...	Punchum.
	Surgeon-Major J. Barter[2] ...	
	Hospital Assistant Shiek Shubrati[3]	
Raipur ...	Surgeon G. W. Trimmel ...	Moula Bux.[4]
		Krishen Rao[5].
Sambalpur ...	Hony. Surgeon J. E. Harrison ..	Samsoonder Dass.[6]
		Paras Ram.[7]
Chanda ...	Apothecary M. Craggs ...	Assistant Surgeon Haran Chunder Dutt.[8]
		Ram Chunder.[9]
		Seeta Ram[10].
Sirohcha ...	Surgeon J. W. Guffney ...	Ragavaloo Naidoo.

[1] To 18th February 1877.
[2] From 19th February to 4th March 1877.
[3] Since 5th March.
[4] To 31st December 1876.
[5] Since 1st January 1877.
[6] To 22nd April 1876.
[7] Since 23rd April 1876.
[8] To 26th July 1876.
[9] From 27th July to 30th September 1876.
[10] Since 1st October 1876.

Observatories in Madras.—On the subject of these stations, I regret that I am able to say no more than can be inferred from the reduced registers transmitted to me by Mr. Pogson, as I have received no report from the Meteorological Reporter, nor any other communication beyond the formal dockets which accompany the registers. Kurnool was discontinued in May 1876, but I have not yet heard of the establishment of the sanctioned observatory at Mangalore, which is much required; since, excepting Goa, there was in 1876 no observatory on any part of the west coast between Cochin and Bombay. Judging from what I saw of the observatories in 1875, and from Mr. Pogson's well-known care and experience, I have no doubt that the work of the observatories is good; but it would have been more satisfactory had I been able to give some further information respecting them. No hourly registers have been sent to me from the two stations at which second class observatories were sanctioned, and I am unable to say whether any have been taken. I have, however, no reason to believe that any change whatever has been made in the system.

Observatories at the Andamans and Nicobars.—The two observatories of Port Blair and Nancowry have been superintended by Dr. J. Dougall, who succeeded Dr. Rean as principal medical officer at the beginning of 1876. One change of importance has been made at Port Blair, *viz.*, the observations have been taken by the Apothecary, Mr. F. J. Carreck, instead of the native convict who was formerly employed, and there has been unquestionably a considerable improvement in the work. Moreover, a shed has been provided for the thermometers, similar to that in use at other stations. The accurate elevation of the Nancowry barometer is still wanting; no determination having been made since it was removed, by myself, from the thermometer shed into the hospital, in December 1875. There is, however, a very small difference between the elevations of the present and former sites. The names of the observers are as follow:—

Stations.	Superintendent.	Observers.
Port Blair ...	Surgeon-Major J. Dougall, M. D.	Mr. F. J. Carreck.
Nancowry ...		„ E. C. Radford.*
		„ J. Peters.†

* From April 1876 to February 1877.
† From March 1877.

Observatories in Burmah.—The re-furnishing of the sanctioned Burmese observatories was delayed for some time, owing to the want of verified instruments; the assistant who was entrusted with that work having been fully occupied with testing the instruments for the whole of the stations in Northern and Central India. Two observatories, Rangoon and Moulmein, were nevertheless at work during the whole of 1876, and have yielded very satisfactory registers.

Bassein began work on the 1st January 1877, and verified instruments have been supplied to Thyetmyo and Mergui before the close of the year.

These stations in Burmah are a very important addition to the pre-existing system. Hitherto nothing has been accurately known of the distribution of temperature and pressure, and of the prevalent wind directions on any part of this coast south of Akyab. It now appears that, as compared with the opposite coast of India, a low temperature and high pressure characterize the Burmese Peninsula during the greater part of the year; and there is a remarkable increase of pressure between Rangoon and Moulmein on opposite sides of the Gulf of Martaban, which may probably be attributed to the influence of the axial mountain chain of Tenasserim. The data from Bassein, Mergui, Thyetmyo and Tounghoo may be expected to afford an important further extension of our knowledge. At Rangoon, Dr. A. Crombie was Superintendent, and Mr. A. E. Compagnac, the Observer. At Moulmein Dr. DeFabeck was Superintendent of the observatory. Akyab has been included among the Bengal stations.

Extra Indian Observatories.—In July 1875, Colonel Ross, Her Majesty's Resident at Bushire, proposed to undertake a meteorological register at that port, under the provisions of the rules for the issue of meteorological instruments, which lately received the sanction of Government. The station is important, as lying about midway between Kurrachee, the westernmost station of the Indian system, and the Russian observatory of Tiflis; and it thus tends to link the Indian system with that of Europe. During the greater part of the year, the work has been carried on by Colonel Prideaux, Colonel Ross having been absent on leave.

Another important observatory beyond the British frontier, is that at Leh, which was originally established by Mr. R. B. Shaw, and has now been in steady operation for three years. During the last year, hourly observations have been recorded there on four days in each month as at second class stations in India, and they are of very great interest, owing to the great elevation of the station, and its position in the very heart of the greatest mountain system in the world.

The observatories sanctioned for Mandalay and Bhamo have not yet been established.

Methods of observation and other constants.—Sheds for the shade thermometers, of the same pattern as those used elsewhere in Northern India, have now been provided at all the stations in the Punjab, to replace the open stands formerly in use in that province. At the same time, Dr. Neil, the Meteorological Reporter for the Punjab, has continued to record the readings of instruments suspended on the open stand at Lahore, with a view to comparing the results with those of the instruments under the regulation shed. These will be very useful as a guide for the future, since the climate being one of extreme ranges of temperature, and in general, of great dryness, the difference produced by the greater exposure to radiation will be shewn very effectively; and as, hitherto, the open stand has been a very favorite method of exposure, the datum may be useful to correct roughly past registers of temperature.

Two other changes in the exposure of instruments, of some importance, have been introduced generally. Both the thermometer for shewing the intensity of the sun's radiation, and that for shewing the diathermancy of the air at night, are of necessity so greatly affected by the radiation of objects round about, and, as hitherto exposed, especially by that of the ground immediately beneath them, which last varies indefinitely, that the registers of these instruments, not only at different stations, but sometimes even in positions only a few feet distant from each other, were found to vary considerably. In order, to some extent, to neutralize these purely local influences, the sun thermometers have now been very generally exposed on a form of stand 4 feet high, having a cage of sharpened wires to keep off birds; and the minimum thermometer, instead of being placed immediately over grass (or the bare ground, where grass will not grow), has been laid on a pad of country blanket, one inch thick; and this, being a bad conductor, renders the radiation of the supports practically uniform.

I believe that, in nearly all cases in which the barometer was formerly exposed in an open shed (to the full range of air temperature), it has now been removed to a more or less enclosed building.

Summary.—To sum up the general results described in detail in the foregoing pages. There were on the 31st March 1877 ninety observatories at work in India and its dependencies (excluding Ceylon) and one in the Persian Gulf. Of these, eighty-two were under the direction of the Meteorological Department; and eight either private or independent, under other departments or volunteers. All, except the private observatories, had been furnished with barometers and thermometers which had been verified, and the readings of which can be corrected to those of well-known standards. The elevations of nearly all the barometers have been determined with such accuracy as is possible; only one or two are still of somewhat doubtful validity. Thus the observations of temperature and pressure, throughout the length and breadth of the land, are so far rendered comparable with each other. The exposure of the instruments for air temperatures has been rendered practically uniform at all the stations, and that of other instruments as far as possible; thermometers (for shade temperatures) and hygrometers being exposed under open sheds, barometers in inner rooms, sun thermometers on stands 4 feet high,* and thermometers for night radiation on pads of blanket. All the observatories furnish readings at 10 A. M. and 4 P. M., and some at other hours in addition. Hourly readings on four days in each month are recorded at the following stations:—

Leh,	Hazaribagh,
Lahore,	Goalpara,
Roorkee,	Sibsagar,
Agra,	Chittagong,
Lucknow,	Cuttack,
Allahabad,	Nagpur,
Jubbulpore,	Pachmarhi,
Patna,	Rangoon,

and on one day in each month at—

Belgaum,	Kurrachee,
Poona,	Deesa,

and autographic instruments are in use at two, *viz.*, Calcutta (Alipore) and Bombay.

METEOROLOGICAL OFFICERS AND OFFICE WORK.

The *personnel* of the superintending staff is as follows:—

Province.	Superintending Officer.	Name.
Bengal and Assam ...	Meteorological Reporter for Bengal	J. Eliot, M. A.
N. W. Provinces ...	Ditto N. W. P....	S. A. Hill, B. A.
Punjab	Ditto Punjab ...	Dr. A. Neil, M. D.
Bombay, Rajputana and Central India	Ditto Bombay, &c.	F. Chambers.
Berar	Sanitary Commissioner	Dr. Abbott.
	Metl. Reporter for Bombay ...	F. Chambers.
Central Provinces ...	Sanitary Commissioner ...	Dr. Townshend.
	Metl. Reporter for India ...	Dr. J. Brake.
Madras	Meteorological Reporter ...	H. F. Blanford.
Andaman Settlements ...	Chief Medical Officer ...	N. R. Pogson.
	Meteorological Reporter, India ...	Dr. J. Dougall.
Burmah	Sanitary Commissioner ...	H. F. Blanford.
	Meteorological Reporter for India ...	Dr. Kelly.
		H. F. Blanford.

The transmission of the registers from the observatories to the offices of the Meteorological Reporters has been accelerated by the arrangement which leaves all the work of reduction to be carried out in the latter. There has also been an acceleration in the transmission of the reduced registers to the central office

* Except in Madras, and at many of the stations in Bengal and the North-Western Provinces, where, with a view to continuity, the old system has been adhered to.

in the case of Madras, the North-Western Provinces and the Punjab. This will probably admit of the discussion of the meteorology of the year 1876, and the preparation of the annual report being completed and published at an earlier date relatively than that of 1875. But the time has now arrived when we must endeavour to obtain and collate the returns more speedily; to study the weather changes from day to day, as they occur; and to learn, not only what are the general features of the climate or season, (which is all that our means have hitherto allowed,) but also the order in which weather changes succeed each other, and how each part of the country is affected by them. Hitherto our attention has chiefly been given to the study of mean results and averages; we must now turn to that of the detailed phenomena, and we must resort to those methods of daily reporting, and the daily preparation of synoptic charts, which have proved so valuable and so fertile in results in Western Europe, and especially, and on an extended scale, in the United States of North America. Hitherto this method has been resorted to in India, only retrospectively, in one or two exceptional cases, and for special objects; for instance, with a view to trace out the causes of certain instances of remarkably heavy rain-fall in the monsoon rains of 1875, and, by Mr. Eliot, in his recently issued report on the Vizagapatam and Backergunge cyclones. These experimental essays have sufficed to show that the data now yielded by the great majority of the observatories are sufficiently trustworthy for the purpose; and some preliminary arrangements are now in progress to carry out the system regularly, and after no longer interval than is required for the transmission of the daily registers by post. It will be wise to content ourselves with this less expeditious means of communication until the system shall have been brought into working order, and until we shall be enabled by actual experience to pronounce on the value of the results. But I look upon the use of the Post Office for this purpose as merely transitional; and I think the time is not far distant when we shall be justified in resorting to the telegraph on a far more extensive scale than hitherto for the communication and diffusion of weather reports.*

The general work of reduction has been facilitated by the distribution of the printed tables referred to in my report of last year. It will be further simplified by preparing from them special tables for the barometric reductions of each station.

The work of the local Meteorological Reporters' offices has consisted almost exclusively in making the primary corrections and reductions of the registers of the observatories in their respective provinces. Mr. Eliot has, however, prepared a paper, on certain anomalous barometric changes, in connection with rain-fall, and a report on the cyclones of Vizagapatam and Backergunge, to which I shall have occasion to refer more at length presently. The Bengal registers were completed among the first. Mr. S. A. Hill has also sent in his reduced registers for the North-Western Provinces expeditiously, and has prepared a paper on the winds and rain-fall of Benares, which will be published in the Indian Meteorological Memoirs. The Punjab registers were received somewhat later; but the office establishment in Lahore, in proportion to the number of stations, is smaller than in the two other provinces. The registers for many of the Madras stations were received at short intervals during the year, frequently within one or two months of their respective dates; but the complete series was not in my hands until the 4th July of the present year. From Bombay, the last of the registers were received a few days earlier. Mr. Chambers has had in hand also the discussion of the wind registers of Kurrachee, for which work a special temporary establishment was sanctioned. This work should now be near completion. He has also communicated to the Royal Society a short paper on the diurnal variation of winds of Bermuda; which is of interest, as affording further confirmation of the influence of the diurnal oscillations of atmospheric pressure on the movements of the atmosphere.†

The new edition of the manual of instructions for the guidance of Meteorological Observers has been completed during the year, (the matter of the original edition having been doubled in amount,) and has been issued, together with the

* Since the above was written, the proposed system of daily reports has been sanctioned by the Government.

† I am, however, quite unable to accept Mr. Chambers' views of the relations of the two classes of phenomena which he discusses in the paper, as I have elsewhere pointed out.

tables of reduction, specially drawn up for use in India. With a view to the dissemination of the more important results of the meteorological work in India, and also to encouraging rational enquiry, it has seemed to me desirable to supplement this little work by a sketch of the meteorology of India, as now known, together with an introductory chapter on the physical laws of the atmosphere, and an outline of the physical geography of India. This is now completed and almost ready for publication. The whole, which forms a separate volume, exclusive of the tables, will form an octavo volume of about 300 pages, to be published under the title of the "Indian Meteorologist's Vade-Mecum."

The materials for the report on the meteorology for 1876 are well advanced, and a part is now in the Press, the remainder being under discussion. The charts illustrating the meteorology of each month of the year are in the lithographers' hands.

The observations on the diurnal variation of pressure, temperature, &c., recorded at Calcutta during the past 24 years, and at Hazaribagh, Patna and Sibsagar during shorter periods, are in great part reduced, and well advanced for publication in the "Indian Meteorological Memoirs."

The old rain-fall records of sudder and other important stations in the North-Western Provinces, Berar and the Central Provinces, and those of the Bombay Presidency for the last ten years, have been collected and tabulated, with a view to their discussion and eventual publication, when those for the remainder of India shall have been collated in like manner.

Publications.—The publications issued by the office during the past year are:—

1. Report on the meteorology of India in 1875.
2. Part I of the Indian Meteorological Memoirs.
3. Part I of the "Indian Meteorologist's Vade-Mecum."

The first of these comprises the condensed results of eighty-seven stations, exclusive of one hundred and eleven stations for which the rain-fall only is given, and includes eight in Ceylon; also, the full registers of five stations, *viz.*, Nagpur, Lucknow and the three presidency capitals.

The second contains three papers, *viz.*:—

1st.—On the winds of Calcutta.
2nd.—On the climate and meteorology of Kashghar and Yarkand.
3rd.—On the diurnal variation of barometric pressure at Simla.

The Meteorological Office for Bengal has also published Mr. J. Eliot's report on the Vizagapatam and Backergunge cyclones of October 1876, already briefly referred to above. In this report, Mr. Eliot has given a very full discussion of the formation and progress of these two storms, based on data, partly collected from the shipping which had encountered the storms in the Bay, partly furnished by the registers of the observatories around the coasts; and, in connection with his description of the latter storm, he has given as complete an account of the disastrous flood which submerged the low-lying alluvial tracts at the mouth of the Megna, as could possibly be framed from the apparently conflicting evidence of the panic-stricken survivors. But the most valuable portion of the report, and that which more especially entitles it to rank as marking a distinct advance in our knowledge of cyclone laws, is that which deals with the atmospheric conditions that precede cyclones, and with the rational theory of their genesis; for it is only as a deduction from this knowledge that we can pronounce with confidence what are the most trustworthy prognostics of cyclone formation.

Mr. Eliot has shewn that, antecedently to the formation of the cyclones referred to, there was great uniformity in the barometric readings all round the coasts of the Bay; and the same peculiarity has also been noticed by myself and the late Mr. W. G. Willson in the case of former storms. It has further been established by the evidence of ships' logs, that, at such times, a higher pressure prevails to the south, in the neighbourhood of the equator; that ships crossing the Bay meet with calms or light variable winds; and, in the tract where the cyclone is in process of formation, with heavy and continued rain. In this early stage of cyclone formation, indeed, the Bay of Bengal somewhat resembles, in its meteorological features, the ordinary condition of the Atlantic doldrums;

and, as in the belt of calms, the effect of the continued precipitation of the rain is probably to raise the temperature of the cloud-forming strata, by the emission of the latent heat of the condensed vapour, and to lower the atmospheric pressure. The conditions of pressure being such as do not admit of the vapour (produced over the Bay and the equatorial sea to the south) being carried away by any air current and discharged over the land, it falls in torrents of rain over the cradle of the future cyclone. Thus is explained another peculiarity to which Mr. Eliot has prominently drawn attention, *viz.*, that during the formation of a cyclone, but little rain falls on the land; especially in Bengal and on the coasts of India. At the same time, and as a consequence of the falling pressure over the Bay, a gentle circulation of the atmosphere is set up around the coasts. The southerly winds that are thus set in motion on the Arakan coast, and the north-easterly winds which form part of this circulation in Bengal and on the coasts of Orissa and Madras, have been regarded by some as parallel winds which generate the cyclones. But this is evidently an error. In many cases, perhaps in all, they are very light, having no greater velocity than three or four miles in an hour; and it may easily be shewn to be a mechanical impossibility that they should in any material degree contribute to the energy of the barometric depression, which is the immediate source of that of the cyclones. On the other hand, it has been demonstrated by Reye, by a calculation of the heat energy emitted in the formation of the rain in a cyclone, that this latter is ample for the production of the fiercest storm.

Mr. N. R. Pogson has published a tabular statement of the rain-fall registered at the Madras observatory in every month during the last 62 years. The data given in this table have been recently discussed by Dr. W. W. Hunter, with reference to the periodicity of droughts and famines in Southern India, in a pamphlet which has obtained a wide notoriety, and has attracted very general interest.*

Short papers on the following subjects have been contributed to different periodicals as follow:—

1. An account of experiments in 1875 and 1876 in various parts of India, for the purpose of comparing the observed temperature of the dew-point with that computed from the psychrometer by different methods of reduction. *Journal, Asiatic Society, Bengal.*

2. On the physical explanation of the inequality of the two semi-diurnal oscillations of barometric pressure. *Proc., Asiatic Society, Bengal,* August 1876, and *Journal, Asiatic Society, Bengal, 1876.*

3. Note on the variation of the barometric tides in connection with land and sea breezes—*Journal, Asiatic Society, Bengal, 1877,*—and a paper on the same subject to the *Zeitschrift der Oester. Meteorol. Gesellschafft.*

Library.—With the exception of a few periodical publications, nearly the whole of the additions to the Library during the past year have been presentations, or works received in exchange for the office publications. The Office Library is not large, and is restricted, as far as possible, to works on meteorology, and such others as are frequently in use in the discussion of meteorological subjects. It now fills two double book-cases, measuring 7 feet × 7 feet 8 inches, and consists of 740 bound volumes and about two hundred pamphlets, unbound parts of volumes, &c. The whole is in excellent condition.

The following list of books presented and purchased shew the additions made between the 1st April 1876 and the 31st March 1877:—

Presentations to the Library from the 1st April 1876 to the 31st March 1877.

Place.	Donor.	Title of Work.
Armagh	... The Rev. T. R. Robinson, D.D.	Reduction of anemograms taken at the Armagh Observatory in the years 1857—63.
Bombay	... Government of Bombay	... Twelfth Annual Report of the Sanitary Commissioner, Government of Bombay
Brussels	... Royal Academy of Sciences ...	Bulletins de L'Academie; 2 Serie, Tomes XXXVII to XL.
		Annuaires de 1875 et 1876.

* Having investigated the questions treated of in Dr. Hunter's pamphlet with a wider field of materials, I have been compelled to conclude that Dr. Hunter's results require some limitation. A special report has lately been submitted to Government. The subject is still engaging the attention of more than one officer in the Department.

Place.	Donor.	Title of Work.
Brussels	... Observatoire Royal	... Meteorological observations for January to December 1876.
Calcutta	... Government of India, Department of Revenue, Agriculture and Commerce.	General Report of the operations of the Marine Survey of India from 1874 to 31st March 1876. Report of the Forest Administration of the Hyderabad Assigned Districts for 1875 and 1876. Code of the Financial Department (Civil Pension Code, Civil Leave Code, Acting Allowance Code), third edition. General Report on the operations of the Great Trigonometrical Survey of India, during 1874 and 1875. Report on Meteorology, &c., in Oudh, 1875-76. Report on the cholera epidemic of 1875 in India.
Ditto	... Sanitary Commissioner, Bengal	Report of the Sanitary Commissioner, Government of Bengal, for 1875.
Ditto	... Government of Bengal ...	A Statistical Account of Bengal, Volumes 1—5. Administration Report of Bengal for 1875-76.
Ditto	... Government of India, Home Department.	Report of the Meteorological Committee of the Royal Society for the year ending 31st December 1875.
Ditto	... G. R. Elson, Esq. ...	A few words about October cyclones and their prognostics, as experienced at the Pilot stations off the mouth of the Hooghly.
Ditto	... Geological Survey of India ...	Memoirs of the Geological Survey of India, Volume 12, parts 1 and 2, Volume 13, parts 1 and 2.
Cape of Good Hope	Observatory	Meteorology of the Cape of Good Hope.
Christiania	... Norske Meteorologiske Institut.	Bulletin Météorologique du Nord; from August to December 1876, with title page. Études sur les mouvements de l' atmosphére by C. M. Guldberg and H. Mohn, Part I.
Ditto	... Meteorological Institute, Norway, Sweden and Denmark.	Meteorological observations, February to July, 1876.
Copenhagen	... L'Institut Météorologique Danois.	Annuaire Météorologique pour l' Année 1871, part 1. Le Diétherescope.
Ditto	... Royal Danish Academy of Sciences.	Det Kgl. Danske Videnskabernes Selskabs; oversigt No. 3 of 1874, Nos. 1, 2 and 3 of 1875, and No. 1 of 1876. Tables Météorologiques de Copenhagen pour 1874.
Edinburgh	... R. Tennent, Esq. ...	The theory of the causes by which storms progress in an easterly direction over the British Isles, and why the barometer does not always indicate real vertical pressure.
Ditto	... Scottish Meteorological Society	Journal, New Series, Nos. XLVII to L.
Goa ...	... Observatory	Meteorological observations for July to December 1875. Meteorological observations for January to June 1876. Feicoes Meteorologicas de Goa.

Place.	Donor.	Title of Work.
Havanna	... Real Colegio de Belen ...	Observaciones magneticas y meteorologicas del Colegio de Belen, Havanna, 1872-73.
Hongkong	... Government Civil Hospital ...	Meteorological observations taken at the Government Civil Hospital, from January to August and October to December 1876 and January 1877.
Lahore	... Meteorological Reporter, Punjab.	Punjab Meteorological Report for 1874.
London	... Meteorological Office ...	Bulletin international de l'observatoire de Paris for August 1873, August 1874, and August 1875. Hourly readings of the seven British observatories, for July 1875 to September 1876. Memorandum on the organization of the office, &c., and digest of the Annual Reports since 1867. Quarterly weather report, Part II, 1874, April—June. Physical Geography of the part of the Atlantic which lies between 20° north and 10° south, and extends from 10° to 40° west. Meteorologisk Aarbog of Institut Météorologique Danois for 1874. Contributions to the meteorology of Japan. Daily weather reports, July to December 1875. Report of the Meteorological Committee of the Royal Society for 1875. Meteorological Log. (*Book of Forms*) Instructions for keeping the meteorological log. Meteorological observations at stations of the 2nd order, Part I, January to May 1875. Report of the Permanent Committee of the first instrumental congress at Vienna. Remarks on the present condition of maritime meteorology.
Ditto	... The Editor ...	Symon's monthly meteorological magazine, March 1876 to February 1877.
Ditto	... Meteorological Society ...	Quarterly Journal, new series, volume III, Nos. 17 to 20. List of Fellows of the Meteorological Society, January 31st, 1876. Catalogue of the Library of the Meteorological Society, revised to December 1876.
Ditto	... Society of Arts ...	Journal Nos. 1214 to 1265.
Ditto	... Royal Society	Proceedings Nos. 164 to 175.
Ditto	... Kew Committee ...	Results of observations of magnetic dip, horizontal force and declination, made at the Kew observatory from April 1869 to March 1875, inclusive. Report of the Kew Committee on the work done in the meteorological office since their appointment in 1866 to December 31st, 1875.

Place.	Donor.	Title of Work.
London	... The Publishers	... The Colonies; Nos. CCVII to CCXVI and CCXVIII to CCXXVIII & CCXXXIII & CCXXXV.
Ditto	... Royal Asiatic Society	... Journal, new series, volume VIII, Parts I & II.
Ditto	... India Office ...	... Abstract of the reports of the surveys, and of other geographical operations in India for 1873-74.
Ditto	... A. M. Festing, Esq., F. M. S.	Description of a new form of barograph.
Lucknow	... Superintendent, Scientific Department.	Report on meteorology, &c., in Oudh in 1875-76.
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Mauritius	... C. Meldrum, Esq., Director ...	Mauritius meteorological observations for 1874. Mauritius meteorological results for 1875. Annual Report of the observatory for 1875.
Montsouris	... Meteorological observatory ...	Bulletin mensuel de l'observatoire de Montsouris; Tome V, annee 1876, Nos. 49, 55 and 57 to 60. Annuaire 1877 météorologie.
Munich	... Bavarian Academy of Sciences	Abhandlungen der mathematisch Physikalischen Classe; Band XII, Abth. I and II.
Melbourne	... Observatory	Monthly record of results of observations in meteorology, &c., during December 1875, and January to August 1876.
New York	... Daniel Draper, Director ...	Annual report of the New York observatory for 1874-75.
New Haven, Connecticut.	Connecticut Academy of Arts and Sciences.	Transactions, Volume III, Part I.
New Zealand	... Wellington Observatory ...	Abstract of observations in New Zealand from September to December 1875, and January to July 1876. Comparative table of climate as observed at the meteorological stations in New Zealand during 1876. Meteorological observations in New Zealand during 1874.
Oxford	... Radcliffe Trustees ...	Results of meteorological observations made at the Radcliffe observatory in 1874.
Paris	... M. Harold Tarry	... Histoire de l'atmosphére en Avril 1876, Juin et Août.
Prag	... K. K. Sternwarte	Astronomische magnetische und meteorologische Beobachtungen in Prag, 36 Jahrgang, 1875.

Place.	Donor.	Title of Work.
Philadelphia	... Franklin Institute ...	Journal, volume XCIX, Nos. 588-593, volume C, Nos. 594-600, volume CI, Nos. 601-610, volume CII, Nos. 612 and 613. Supplement of Journal, volume CI, No. 602.
Pesaro	... Observatory ...	... Sheets of meteorological curves from January to December 1876.
Purneah	... W. McGregor, Esq. ...	Protection of life and property from lightning during thunder-storms. On the prevention of accidents by lightning.
Shanghi	... Observatoire de Zi-ka-wei ...	Bulletin des observations, September 1874 to December 1875. Magnetisme, 1874 and 1875.
Singapore	... Dr. H. L. Randell, Principal Medical Officer ...	Meteorological observations from August to December 1875. Register of rain-fall from August to December 1875. Annual abstract of observations for 1875.
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Sydney	... Government Observatory ...	Meteorological observations for October 1875 to May 1876. Results of meteorological observations made in New South Wales during 1874.
Toronto	... Meteorological Office, Toronto, Canada.	Fifth annual report of the meteorological office of the dominion of Canada.
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APPENDIX I.

Extract from Mr. S. A. Hill's Report.

During the past year I have visited eight of these stations, *viz.*, Chakrata, Ranikhet, Dehra, Roorkee, Bareilly, Agra, Benares and Sutna. Bareilly, Ranikhet and Agra were inspected in June 1876. At the first station I found everything in good order, and the observer apparently well up to his work.

The barometer, formerly employed, had leaked so as to become useless about six weeks previously, and an old instrument of doubtful accuracy had been substituted for it. A correction for this instrument has since been determined; and so the readings taken while it was in use, 16th April to 24th July, have been rendered available for comparison with those of other stations.

The rain-gauge I found placed on the roof of the college building; it has since been removed to the enclosure protecting the radiation thermometers, and fixed with the mouth of the funnel about ten inches above the ground.

A short time before I reached Ranikhet, the observatory had been removed to another position, as the old site was required by the Military authorities for the purpose of building barracks. The new site is on a projecting spur stretching to the south-west, and, but for the neighbourhood of some large trees, it affords a good exposure all round. The barometer, as well as the other instruments, was kept in a little octagonal wooden shed at the time of my visit, but towards the end of the year it was removed to a house built for the Observer close by. The barometer at this station also had leaked considerably; and this, together with the defects attending the position in which it was placed, rendered the barometric returns valueless for some months. Since the grant of Rs. 30 per mensem to the Superintendents of third class stations was discontinued, there has been great difficulty in getting men to undertake the work—a difficulty which has not yet been entirely overcome at Ranikhet, where the former Superintendent very naturally refused to have anything to do with the observatory after his pay was stopped. For some time, therefore, I was obliged to deal directly with the Observer, and I still receive the returns direct from him, though the Cantonment Magistrate has kindly undertaken to see after the safe custody of the instruments, and to superintend any building that may be going on.

At Agra I found everything satisfactory, except the position of the thermometer cage. This is kept inside a shed belonging to the hospital attached to the medical school, but the roof of the shed then wanted repairing, and it is situated so near to the wall of the compound, and so closely surrounded by trees, that the air cannot circulate through it as freely as is desirable. As there was very considerable difficulty in obtaining a more open site in the neighbourhood, all I could do was to order what repairs were necessary to the shed at present in use.

Shortly after the establishment of the observatory at Sutna, Dr. Goldsmith asked me to come and see if all the instruments had been put up properly. I found everything nearly as it ought to be; and the same may be said of Benares, which I visited in October, taking with me a set of verified thermometers for use in the observatory.

At the end of November I joined the Meteorological Reporter to the Government of India in a tour he was making through some of the stations in these provinces. The first station we reached was Roorkee, where the observatory is under the superintendence of Dr. Murray Thomson, formerly Meteorological Reporter for the North-Western Provinces. All the instruments appeared to be in proper order, but the wooden roof of the thermometer shed appeared to require a further covering of thatch, to enable it to protect the thermometers properly from the radiation of a May sun. This improvement will be effected during the present month. We then went on to Dehra and Chakrata. At the latter station we found the thermometer shed in a very ricketty condition, with wide openings in the roof, and the wind-vane fixed on the top, in a quite inaccessible position. The shed has since been repaired, and the wind-vane and anemometer fixed on the top of a couple of stout posts, bound together above by a platform, to which access is obtained by means of a ladder. The barometer was found to read about 5 hundredths of an inch too low, probably owing to a little air in the tube. It was removed, and a new instrument left in its place.

Of the returns obtained from the fourteen stations, I think those from the following are perfectly reliable, *viz.*, Dehra, Roorkee, Bareilly, Agra, Lucknow, Allahabad, Benares and Sutna. Somewhat less valuable are the registers from Chakrata, Gorakhpur and Ajmere, while in those from Meerut, Jhansi and Ranikhet, where the barometers have been kept outside in the thermometer sheds, the apparent daily range of pressure must be wide of the truth. The same remark applies, in part, to the temperature returns from Agra and Allahabad, where the observatories are too closely surrounded by trees. The observers all appear to perform their work honestly, but one or two of them are not so intelligent as they might be.

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Central Office.—The staff of the office has increased by the addition of a clerk to compile the weekly register of rain-fall since the 1st of July 1876. This work was formerly under-

taken by the Superintendent of the Government Press, acting under the instructions of the Board of Revenue; but it was made over to me by a letter of the North-Western Provinces Government, No. 930A of 1876, dated 9th June 1876, in which the pay of the rain-fall clerk was sanctioned. This clerk has since been transferred to the regular meteorological establishment by the Government of India letter No. 180, dated 30th November 1876, to the Meteorological Reporter to Government of India.

Monthly Meteorological Abstract.—An abstract of the observations from all the stations, together with a short preliminary discussion, has been regularly published every month in the *North-Western Provinces Gazette.* Copies of the original registers have been forwarded to Calcutta for incorporation in the annual report.

Weekly Rain-fall Reports.—Weekly reports of the rain-fall at the various police and tahsili stations in the North-Western Provinces and Oudh, have been published regularly in the Government Gazette. The returns for the early part of 1876 have also been gone through carefully, and an abstract of the rain-fall during each month of 1876 was published on the 10th January 1877.

APPENDIX II.

Extracts from Mr. F. Chambers' Reports.

Para. 3. *Inspection of Stations.*—At the end of the official year 1875-76 I had already inspected three out of the four old observatories, and had visited the proposed new stations in their neighbourhood. Early in April I went to examine the fourth observatory, Deesa, and during the same tour visited Mount Abu, Ahmedabad, Broach and Surat.

4. *Deesa Observatory.*—Deesa is a good station for general meteorological purposes. The cantonment is situated on gently rising ground in the midst of an extensive open sandy plain. A few outlying spurs of the Aravali range are visible to the north-east, and others, more towards north, can also be seen on clear days. The neighbourhood of the hospital, where the observatory is located, is now so thickly studded with trees as to render the observations of the wind very defective, and I have been compelled to choose another site for the large anemograph which is to be erected at Deesa. The thermometer shed also would with advantage be moved to a more open position. Most of the instruments in use were found to be in good order. Their errors were determined. Radiation thermometers were left to complete, as far as possible, the set of instruments. A Regnault's Hygrometer was also left at this station.

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5. *Abu Observatory.*—From Deesa I went to Mount Abu, and on arrival there found an observatory on a small scale already in existence at the sanitarium. The substitution of a mercurial barometer I took with me, for the aneroid in use, and the utilization of a mercurial minimum thermometer, which was found lying unused there, completed, with the exception of an anemometer and a wet minimum thermometer, the set of instruments; and I was able to arrange for registers to be furnished to the Bombay office from the beginning of May. There are several almost inaccessible peaks around the sanitarium, and consequently the wind observations can be expected to possess only a secondary value. It might be possible to arrange hereafter for an electrical anemometer to be placed on one of these peaks, its indications being registered at the telegraph office or sanitarium; but it would probably be difficult to keep an instrument of this kind in good order in such a situation.

6. *Surat Observatory.*—On my return journey, Ahmedabad, Broach and Surat were visited, to select the most suitable station of the three for a new observatory. Surat was finally chosen, though great difficulty was experienced in finding a suitable site for all purposes at each of these stations; and it will be necessary, at Surat, either to incur considerable expense in properly erecting a wind instrument, or to arrange separately for the wind observations to be made in the town, some distance from the native regimental hospital, where most of the instruments would be most suitably placed.

7. *Malegaon and Indore Observatories.*—At the end of September I went to inspect the stations Nasik and Malegaon, Mhow and Indore, two of which were to be selected for meteorological stations. Malegaon and Indore have been chosen.

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9. *Neemuch Observatory.*—My last journey in the year under report was one to Neemuch, involving 370 miles of tedious travelling by road. I took with me a set of instruments for this station, selected a suitable site, trained an observer, and before leaving started the meteorological registrations.

10. The total distance I have travelled since taking up the Reportership in November 1875 to the end of the year under report is given below:—

	Miles.
By rail	4,210
By steamer	2,011
By road	1,399
TOTAL ...	7,620

11. *Meteorological erections.*—Sheds for the shade thermometers have been erected at Jacobabad, Hyderabad, Bhuj, Surat, Sholapur and Ratnagiri; and others are being erected at Rajkot, Malegaon, Indore, Neemuch and Bikanir. Anemometers have, as yet, been suitably erected at Kurrachee and Bhuj only. For these instruments a special construction has to be devised to suit each station, involving special correspondence with the engineers of each district, many of whom are now severely pressed with famine relief work. Plans for the erection of large anemographs at Poona, Belgaum and Deesa will shortly be submitted to Government, and it is hoped that these erections will be ready for the reception of the instruments on the arrival of the latter from England. Certain repairs that were urgently needed have been executed at the Belgaum and Kurrachee observatories.

12. *Instruments and their verification.*—Complete sets of instruments have been procured, verified and despatched to Jacobabad, Hyderabad, Bhuj, Rajkot, Surat, Ratnagiri, Sholapur, Malegaon, Indore, Neemuch and Bikanir. With the exception of the set sent to Bikanir, whence no report has yet been received, these have all safely reached their destinations, a result which I think may be regarded as one for congratulation, when it is remembered how very fragile such instruments are. Other instruments, to complete sets or replace breakages, have been verified and forwarded to Belgaum, Poona, Deesa, Kurrachee, Abu, Akola, Amraoti, Chikalda and Buldana. These twenty stations are, with one or two trifling exceptions, now fully equipped with the set of instruments for third class observatories.

13. Regnault's hygrometers have also been supplied to Poona, Deesa and Kurrachee; but, owing to an original defect in construction, they have frequently failed to work well. I anticipate, however, that some of the observations that have been made with these instruments will prove to be very valuable.

14. I have made some experiments, which had for their object the inexpensive rectification of the defects of most wind-vanes. All ordinary vanes are subject to oscillations which cause the observation of the wind direction by their means to be more or less indefinite, and often very erroneous. Some are also too insensitive to respond to light winds, but the rectification of this latter defect invariably increases the former one, and something is therefore required, which, while preserving the needful delicacy, will still the oscillations. I have succeeded in devising means to accomplish this end, but the device does not appear to be *inexpensively* adaptable to the requirements of ordinary observers. I have therefore arranged temporarily, that the wind direction observations shall be taken at some stations by observing, with the aid of a small compass, the direction from which a long strip of cloth, tied to the end of a long bamboo fixed vertically on the top of a tree, is blown by the wind. I am of opinion that this plan is much more definite and satisfactory than estimations of the wind direction from an ordinary vane.

15. A few barometers, which were unsuitable for inland stations, have been altered and made serviceable for such places.

16. Thermometers have been compared indirectly with a Kew standard at 32°, and at each ten degrees up to 92° or 112,° barometers with the Bombay Observatory standard, anemometers with the large anemograph at that observatory, and solar radiation thermometers with an arbitrary standard supplied by Mr. Blanford. It is very needful that spirit thermometers, especially, should be compared at every ten degrees of their scales from 32° upwards. The makers often mark them off at each twenty degrees above 32° by comparison with a mercurial thermometer, and divide the intervening space into twenty equal divisions, but by reason of the unequal expansion of alcohol, this practice causes error which often becomes very sensible at the intervening ten degree divisions.

17. *Training of Observers.*—Observers for Sholapur, Surat, Bhuj, Rajkot, Malegaon and Deesa have been trained at the Bombay Meteorological Office, to read and manipulate the various instruments and keep the meteorological registers. At the stations, Abu, Neemuch, Indore, Akola, Amraoti, Buldana and Chikulda, I have, at the times of my visits, partially or completely put the observers through a similar course of training. The observers for Jacobabad and Hyderabad have been taught by the observer at Kurrachee, and the one at Ratnagiri by the Civil Surgeon, Dr. C. Joynt. The Department is much indebted to the Surgeon-General, Indian Medical Department, for the very cordial assistance he has given by causing Hospital Assistants to be available as observers, and by sending them to Bombay, at much inconvenience, for a course of training; and the Surgeon-General, British Forces, has been equally obliging.

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21. At the invitation of Government, several volunteer observers have offered their services. The following stations have been selected and recommended for sanction to the Supreme Government:—

Third class observatories.

Station.	Volunteer observer.
Aden	Surgeon G. W. R. Hay, Port Surgeon.
Ahmednagar	Mr. Hirpaṭák, Head Master of the High School.
Salaru	The Superintendent of Cotton Experiments.
Karwar	The Port Officers.
Rain Gauge Stations.	
Talegáon Dhamdera	Mr. Kashináth Marathi, Subordinate Judge.
Pandharpur	Mr. Lalshankar Umiashankar, Subordinate Judge.

22. *Character of the meteorological registers of the year 1876.*—The registers from the stations Belgaum, Poona, Deesa, Abu, Kurrachee, Akola and Amraoti are, on the whole, satisfactory. The registers of no station have been perfectly free from such mistakes and errors as the best of observers are occasionally liable to make; but I believe that most of such errors, if not all, have been detected and corrected. An aneroid barometer was used at Amraoti from January to March 1876, and these observations are of little or no value; and again for two or three weeks in September, when the regular observer was absent from that station, some of the observations are doubtful. With these exceptions, the work appears to have been well done at all the above stations. At Chikulda and Buldana the work has been less satisfactory, indeed almost useless, for many months of the year. A decided improvement, which, if maintained, will give a very different character to the work of the present year, took place at both stations in December. There have been several breaks in the continuity of the observations at Belgaum, and one at Deesa, on account of sickness of the observers, but with these exceptions the registrations have been uninterrupted at all the stations above mentioned.

Para. 2. The first step towards obtaining, in Berar, uniformity of meteorological registration with other parts of India, was to complete the sets of meteorological instruments at each station and in some cases to exchange instruments that were unsuitable. Having learned what was needed for this purpose, I have verified and supplied to each of the observatories such instruments as were required. As far as the observatories at Akola and Amraoti were concerned, a few detailed directions only were there required to enable them to produce fairly comparable registers. But at Buldana and Chikulda, the observers do not appear to have been able, for lack of training, to profit by such directions, and as it would have been very inconvenient for them to visit Bombay to go through a course of instruction, I have found it necessary to visit those stations. Before the application of the various processes of reduction to the observations made at the four stations in Berar, it was necessary to determine the errors of the various instruments; and for this purpose also, it was desirable that I should visit all the observatories. It was also desirable that I should learn, by personal inspection, the general condition of these observatories, and how such improvements as might be required could best be carried out. With these objects in view I have inspected each of the observatories at Akola, Amraoti, Chikulda and Buldana, and have found them in the condition briefly described hereafter.

Akola.

3. The situation of the observatory is suitable for the observation of all the phenomena recorded, except those of the wind. A special construction, erected on some open spot on the high ground on which the church stands, would be more suitable than the top of the thermometer shed for the exposure of the anemometer and wind-vane. The top of the towers of the Town Hall would also afford a much better site for these instruments than the present one. The indispensable requisite in the exposure of the wind instruments is, that they shall be well raised above trees and buildings, so that the wind shall have free access to them from all directions, without having been obstructed in any way in its previous course.

4. The thermometer shed is not of the pattern adopted by the Meteorological Department; but I am informed that it has been approved by the Meteorological Reporter to the Government of India. A plank which is at present missing from the ceiling might with advantage be renewed. The posts which support the board on which most of the thermometers are fixed, are not firmly placed in the ground, and the readings of the maximum and minimum thermometers are liable to be rendered erroneous in consequence. Some trouble is also experienced from birds and squirrels. To avoid these sources of danger and uncertainty, I propose to supply one of the thermometer cages which are in general use and to give full directions for fixing it properly.

5. The radiation thermometers are placed too near the shed. They should be placed so that they can have an unobstructed view of the whole sky. I would suggest that they be exposed in the middle of the enclosure that was formerly used for the evaporation dish. Before this change is made I propose to supply a special stand for the solar thermometer.

6. The observatory possesses no clock. The observer obtains his time from the striking of one or other of the gongs in the neighbourhood. It would be an improvement on this method if the observer were supplied with a small lever clock which he could take periodically to the telegraph office and have set to true local time.

7. In all other respects the Akola observatory is in a satisfactory condition. The observer is intelligent, and his observations generally stand the test of comparison with each other and with those of other observatories; from which I conclude that his work is also trustworthy.

8. I determined the errors of most of the instruments at several points of their scales by comparison with portable standards. The observations can, therefore, now be corrected and rendered comparable with those made elsewhere. I also gave the observer such further instruction on various points as he seemed still to require.

Amraoti.

9. The situation of the Amraoti observatory, like that of the one at Akola, is a suitable one for most meteorological purposes, but for observations of the movement and direction of the wind it cannot be said to be satisfactory, and the manner in which the wind instruments are exposed is also capable of much improvement. The anemometer is fixed on the top of a post six feet high, but as it is surrounded on almost all sides by trees and buildings, its indications can have little or no value. The wind-vane is also useless, and might with advantage

be substituted [replaced?] by a long strip of cloth fastened to the top of the pole. The top of the clock-tower in the town of Amraoti would be a suitable site for the erection of the anemometer and vane. In this position, the wind instruments would be well raised above surrounding obstructions, and the situation is at a greater distance than the present one from the hills to the south-east, which is also a decided advantage. It would not be advisable, however, to remove the thermometric instruments near the town. They are already located very suitably. Dr. Howard, Civil Surgeon, informs me that there will be little difficulty in arranging for the readings of the wind instruments to be regularly recorded, if the instruments are removed to the clock-tower.

10. The thermometer shed is of the same pattern as that at Akola, but unfortunately the door has been placed on the south instead of the north side. This should be altered. The arrangement of some of the instruments inside the shed is similar to that at Akola, and I would suggest the same alteration as at that station. The observer will then be able to keep his wet-bulb thermometers in better order.

11. It is also desirable that the observatory should be furnished with a clock as recommended for Akola. The anemometer should also be exchanged for a better instrument which can be supplied from the Bombay Meteorological Office.

12. The marine barometer which was in use at Amraoti has already, at my suggestion, been exchanged for a standard instrument that has lately become available. The objection to the use of marine barometers for land observatories is their sluggishness of action, which causes a diminution of range in all the barometric variations of short period.

13. I noticed that the grass radiation thermometer appears to contain a large quantity of air, and that it is in consequence more than usually liable to get out of order. It will be necessary to have this instrument in particular carefully examined daily and to expel any bubbles of air which may have appeared in the bulb or stem.

14. As at Akola, the instrumental errors were determined, and the observations can now be rendered comparable with those of other stations.

15. The observer appears to be an able man, and, judging from his observations, he is also generally trustworthy. He might, however, with advantage be more strongly impressed with the necessity of careful attention to the *cleanliness* of his wet-bulb thermometers and to other precautions that are necessary to keep these instruments in proper order.

Chikulda.

16. The arrangements at the Chikulda observatory are almost exactly like those at Akola and Amraoti, and I would propose the following similar improvements :—

1st.—The erection of a special construction on a mound to the south-west of the hospital for the suitable exposure of the anemometer and vane. These instruments are at present placed on the top of the thermometer shed; but the hospital, kutchery, trees, &c., around are much higher, and prevent the winds from several quarters from gaining free access to the instruments; and consequently their indications in their present positions are of little value.

2nd.—The provision of a cage of the standard pattern in substitution for the board on which the thermometers are now placed.

3rd.—The removal of the radiation thermometer further from the shed.

4th.—That the observatory be furnished with a clock.

17. The time kept at Chikulda appears to be mere guess-work, and it will therefore be necessary, as there is no telegraph office, that a sun-dial should be provided. One of the small universal sun-dials, like the one used at Buldana, will suffice if intelligently used.

18. I found that the observer at Chikulda did not know how to read his barometer, but nevertheless, he appears to have followed some system in his attempts to do so, and it may be possible to make out what his recorded numbers mean. I taught him how to read the barometer and to clean the anemometer, which was found so dirty as to be quite unserviceable. I also gave him such further instruction as the limited time at my disposal permitted, and there is a marked improvement in his observations since my visit.

19. The various instruments were also compared with my portable standards, and their errors determined as at the other stations.

Buldana.

20. The Buldana observatory differs in many respects from those at the other Berar stations, and its situation is very unsuitable for wind observations. The thermometer shed is about nine feet square and is built of brick up to a height of two feet. Above this height, the corners only are carried upward to a height of about eight feet, and the roof is of thick thatch. The sides are filled in with louvre planking. The door is placed at the south side instead of the north. The door itself being of trellis work allows the sun's rays to penetrate into the shed for the greater part of the day. The anemometer and vane are erected close to the shed, on brick pillars not as high as the shed; and there are large trees close by, which must greatly obstruct the free course of the wind. Since the shed was erected, a large new kutchery has been built to the westward, which very effectually prevents the wind from that quarter from acting on the instruments. The barometer and the observer's writing desk, &c., are placed in the shed, side by side with the thermometers, which is not a good arrangement.

21. I would strongly recommend the erection of a thermometer shed of the standard pattern in the hospital compound, and also that a pillar or post high enough to raise the

anemometer and vane several feet above the top of the hospital building be erected in the north-east corner of the hospital compound for the wind instruments. The barometer could then be removed into the hospital surgery, where it would be less exposed to great variations of temperature, and the observer could record his observations there instead of as at present in the thermometer shed.

22. The radiation and grass thermometers are too well protected, *i. e.*, the fence forms an obstruction to a clear view of much of the sky from the position of the instruments. If these were placed within the hospital compound, a less bulky fence would probably suffice for their protection. The rain-gauge might also be placed within the same fence, but the enclosure should be larger than the present one.

23. A thermometer cage of the standard pattern, and a stand for the solar thermometer, could be supplied from the Bombay office.

24. On an examination of the instruments, the three spirit thermometers were found to be out of order. These were put right, and the observer was shown how to keep them so. The barometer, a marine one, was exchanged for one of those which I carried with me.

25. Most of the thermometers were compared at several widely different temperatures with my standard instrument, to determine their errors and enable the observations to be corrected and rendered comparable with those made at other stations.

26. As at Amraoti, it will be advisable to exchange the anemometer for a better instrument from the Bombay office

27. The observer appears not to have had the benefit of a thorough training before he took up the work in April last, and I fear that, in consequence, much of his past work will be useless. I gave him such instruction as the time at my command would permit, and as the Civil Surgeon was good enough to devote a considerable portion of his time to me before I left the station, I was able to leave with confidence that the registers would thereafter show a decided improvement. This has since been found to be the case.

28. I intend eventually to exchange all the thermometers in use at the Berar observatories, except those I have supplied, for new ones that have been verified at Bombay throughout an extensive range of temperature, but this cannot at present be accomplished for want of instruments, and it will probably be necessary to await the arrival of a new supply from England.

29. In concluding this report I desire to acknowledge with thanks the very cordial assistance that was afforded me by the medical officers in charge of the observatories, and more especially for the kind aid given me by Dr. Abbott, the Sanitary Commissioner, who enabled me to visit Chikulda.

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REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1877-78.

1. The system of recording observations which was commenced in Northern India upwards of thirteen years ago, and improved, consolidated and extended to the whole of India upwards of three years since in accordance with the suggestions of Mr. Blanford sanctioned by the Government of India in September 1875, has been working steadily and efficiently during the past year. Several additional observatories in Western India and Burma were established and opened during the year. The Department has now very nearly attained the dimensions laid down for it in Mr. Blanford's sanctioned scheme. The chief duty of the Department will henceforth be the maintenance of the established observatories distributed over India and British Burma in efficient continuous working order, and the utilization of the observations for the scientific investigation of the meteorology of India, and the gradual accumulation of the experience of the relations between the continuous atmospheric changes necessary for prevision.

2. There are two or three directions in which extension of the whole of the observations appears to be desirable, if not essential, to the full and satisfactory working of the Indian Meteorological Department, and which it appears to me ought to be kept steadily in view.

3. The first of these is the co-ordination of the meteorology of India with that of the various countries adjoining the Indian Ocean and also with that of Europe. The comparison of the meteorology of Eastern Africa, the Cape of Good Hope, Australia, Singapore, Batavia, and perhaps China, with that of India, would probably throw much light on the subject of the dynamics of the two great monsoon currents of Southern Asia; and on the even more important question considered from a practical and economical point of view—the variations in the amount of rainfall as depending upon changes in the amount and character of solar radiation, and of evaporation over the area which forms the source of the rains of Southern Asia. The Cape of Good Hope, Natal, Australia and Hindoos

tan are all deeply interested in this matter. Combination on the part of the meteorological authorities of these respective countries seems to be specially desirable; and it is a question whether India, as being perhaps most deeply interested in the general meteorology of the Indian Ocean and its surrounding land areas, ought not to take the initiative in this work of combination. The co-ordination of the meteorology of India with that of Europe and Australia might be partly effected by means of connecting or link observatories. If the light-houses and the telegraphing stations connected with submarine cables were utilized to take daily meteorological observations under proper instructions, this would materially contribute to the completion of the great object of modern meteorologists, *viz.*, the examination of terrestrial atmospheric changes as a whole—and not in isolated groups dependent for their selection on geographical or political divisions. A commencement has been made in this work. General Myer, Director of the United States Signal Service, proposed some time ago that synoptic observations should be taken daily at the same instant, *viz.*, 7-35 A. M., Washington mean time, over the world, and be forwarded to his office for comparison and publication. The proposal was at once received with favour by European meteorologists, and the publication by the United States Meteorological Office of daily bulletins giving simultaneous observations of a very considerable portion of the world, including the whole of North America and Europe, has been going on for upwards of a year. India was invited to contribute observations; Mr. Blanford responded willingly to the request. The first and second class stations in Bengal, Behar, the North-Western Provinces, Punjab, Bombay, the Central Provinces and Madras were selected to take the necessary observations. These (with the exception of the Madras observations) have been taken regularly since June 1877, and are forwarded monthly to Washington. The collection and publication of these observations and the preparation of charts giving the distribution of pressure and temperature, wind direction, rainfall, &c., at the same instant daily over a large portion of the earth's surface will probably continue to be a special feature of the United States Meteorological Service. It will certainly throw much light in a few years on the relations between the meteorological phenomena of the northern hemisphere, and of the relations between the more massive atmospheric movements of the tropical, temperate and polar regions of the earth.

4. The second direction in which extension of the work of observation seems to be desirable is over the whole of the Bay of Bengal, the Arabian Sea, and the northern half of the Indian Ocean. The meteorology of India depends primarily upon the immediate presence of the Indian Ocean. The two monsoons are nothing more than prolonged land and sea winds of six months' duration. There is an incessant action between the land and sea areas, and it will be impossible to thoroughly understand the meteorology of India, if the meteorology of the Indian Ocean is ignored. There are, it is now well known, abnormal persistent variations of pressure in India, sometimes general, but more often local in character. The most striking example of this in recent years is the continuous high pressure over India which almost without exception has lasted from December 1876 to the present month (June 1878). Mr. Blanford has shown that these persistent abnormal variations in many cases can account for irregularities in the local distribution of rainfall in Northern India. Probably, also, differences in the relation of pressure between Burma and India determine the strength of the south-west monsoon

current in each country, and hence also the relative rainfall of each country. It is, moreover, probable that there may be persistent abnormal variations of pressure over the sea area to the south of the Equator, and that these may considerably affect the general strength of the monsoon current or, in other words, determine whether the monsoon current of Southern Asia may be feeble or strong. I have urged the necessity of meteorological observations over the sea area before in connection with the less important subject of the cyclones of the Bay of Bengal. I have reason for believing that much valuable assistance can be obtained from the Captains of the mail steamers plying across the Indian Ocean, and its arms, the Bay of Bengal and the Arabian Sea, more especially the British India and Peninsular and Oriental steamers. When observations over the sea area go on *pari passu* with observations over the land area, then the general relations between the baric gradient over the monsoon area and the strength of the current can be determined. Without giving any further reasons, it is evidently essential for a thorough knowledge of the dynamics of the monsoon current that we should have fairly accurate and complete knowledge of the meteorology of the source as well as of the goal of the south-west monsoon current. Our knowledge of the meteorology of India, and further India, will necessarily remain incomplete until some system of taking observations over the mid and northern portions of the Indian Ocean has been devised, and brought into operation. If this extension be carried out, theory suggests that the general strength of the monsoon current will depend upon, and therefore be indicated by, the previous relative distribution of pressure over the land and sea areas, and that the minor irregularities of rainfall distribution over the land area will depend upon, and be indicated by, the relative distribution of pressure over the land area itself.

5. If this be the true view of one great feature of the work of the Meteorological Department, the extension of the sphere of observation so as to include the record of observations over the northern part of the Indian Ocean should be effected as rapidly as possible. Probably, when the tabulated observations of the Indian seas extracted from the meteorological log books in the Marine Department of the British Meteorological Office have been completed, their discussion by this Office should be undertaken at once. They will undoubtedly throw much light on this question, and at the same time afford information of the highest value to the Captains of vessels navigating the Indian seas. But for the complete investigation of the dynamics of the monsoon current, it is necessary that the observations over both the sea and land portions of the monsoon area should go on *pari passu* for several years.

6. The system of taking hourly observations on certain days has been continued during the year at typical stations throughout India. Materials are now rapidly accumulating for a thorough investigation of the question of the daily oscillation of the barometer in India, and of the peculiarities and variations in its character depending upon geographical and other local features.

7. An almost equally important question from a theoretical point of view is the comparison of observations taken at stations at different levels situated near each other. Amongst other points on which these observations will, it is hoped, throw light, are the following: the rate at which temperature diminishes with elevation at different seasons of the year; the relation between the changes of pressure of the lower and higher strata of the air; the variations of humidity and of the amount of aqueous vapour in the air as depending upon the processes of vertical ascension, and of diffusion, and the rate at

which changes of pressure travel vertically. India possesses many facilities for such observations, and it is a field in which she may reasonably labour for the general information of European meteorologists. It is desirable for such comparison that the stations selected should be at the smallest possible horizontal distance from each other, whilst the vertical distances are considerable, and that the general meteorological conditions should be as nearly similar as possible. The Indian Meteorological Department possesses several pairs of stations which may be used for such a comparison, as, for example, Purneah and Darjeeling, Bareilly and Ranikhet, Nagpur and Pachmarhi, Rawulpindee and Murree, and Roorkee or Dehra and Mussooree. The two last are under the control of the Trigonometrical Survey, but Colonel Walker places the observations at the disposal of the Meteorological Department. This last battery of stations for inter-comparison of the changes at different heights has been still further improved by the establishment of an observatory at the St. Fidelio's School, Mussooree, by the kind voluntary assistance of Father Genesius, the Principal of the School. This will give readings at an elevation nearly midway between Dehra and the Great Trigonometrical Survey Office at Mussooree.

8. One very important addition to the working of the Department was made during the official year. This is the transmission by post daily of the 10 A.M. readings from all the observing stations, except those which, like Port Blair, do not enjoy the advantage of a daily post. Additional establishment for the due reduction of the returns and the preparation of the daily charts giving the isobares, isotherms, wind direction and rainfall was sanctioned, thus enabling the continuous changes to be traced out and the connection between these changes co-ordinated and established. As the returns are sent by post, and several of the more important observing stations, as for example, those in Burma, Rajputana, the Andaman and Nicobar Islands, communicate very slowly with Calcutta, these charts are at present not completed until at least a fortnight after date. Hence the use of the daily postal returns, although a valuable extension, does not enable the Indian Meteorological Department to follow concurrently the atmospheric changes over India. The further extension of this continuous examination of the observations *viz.*, the transmission of weather reports daily by telegraph, has also been sanctioned; and as soon as the working of the daily postal returns warrants the extension, the transmission of daily weather telegrams from all the more important stations, and the daily preparation and publication of the observations and of weather charts, will be undertaken, and form one of the most important and interesting duties of the Department. The final extension in this direction, the publication of weather probabilities, must be begun very slowly and tentatively. India is probably the first tropical country in which this will be attempted. The observations of the Meteorology of India as a connected whole have been only carried on for a very short period (barely four years) in a satisfactory manner. Hence the experience of Indian meteorologists is extremely limited. Moreover, the meteorological conditions of India are so different from those of any European country that European meteorological experience and practice in weather prevision is of little or no utility in India. It will therefore be necessary for the Indian Meteorological Department to utilize the telegraphic information very cautiously for some years.

9. The system of daily transmission of weather reports by post has one important secondary advantage. It brings every observing station into immediate and direct con-

nection with the Central Office. The preparation of the charts by the Reporter enables him to exercise a continuous supervision over the daily work of each observer. The constant comparison of the various readings at neighbouring stations which the preparation of these charts entails enables him with little labour to detect any error arising from indolence, carelessness or ignorance of the observers. This constant check and comparison has already considerably improved the character of the work of observation. The sanctioned extension of the transmission of telegraphic daily reports when introduced will exercise a further beneficial action in the same direction.

10. And in view of the probable importance and permanent establishment of the telegraphic weather service, I shall endeavour, in all cases where any observatory works unsatisfactorily, to arrange for its transfer to the Telegraph Office. In the majority of cases telegraph masters form excellent observers, and as the actual work of taking and registering two sets of observations does not require more than half an hour per diem, it cannot in any way interfere with their telegraphic duties, whilst it gives a small increase of pay to a deserving class of men. All change of position of the observatories is to be deprecated and avoided if possible, but there are a few cases, such as Gya, Mooltan, &c., where from continuous and incorrigible carelessness on the part of the observer, it seems advisable to make the change here indicated as soon as possible, if the general character of the proposal meets with the approval of Government.

11. Great progress has been made in bringing together the rainfall records of past years. In the Punjab, the Lieutenant-Governor has had the old records examined, and so much of them as is trustworthy selected and published in abstract in the local Gazette. The records of the principal stations of Burma as far back as the year 1870 have been communicated to this Office by the Chief Commissioner. The rainfall returns of a few of the stations go back to earlier dates. And, by the order of the Madras Government, all the old rainfall registers of that Presidency, extending back in some cases to 1853, have been lent to the Meteorological Office for the purpose of extracting such portions as may be desired. Materials have been accumulated which, when reduced and discussed, will afford sufficient data to indicate the normal distribution of rainfall over the whole of India. A preliminary rainfall chart has already been drawn up and is now preparing for publication chiefly for the information of the Forest Department. The investigation of the variation of the rainfall of recent years, with a view to the elucidation of such law as may be discoverable, will be shortly undertaken.

12. The greater portion of the meteorological results for 1877 have been prepared, and a part has been sent to the press. In accordance with instructions, the assistance of the printing press at Roorkee has been obtained in order to enable the report for 1877 to be published as soon after the stipulated time as possible (September 1st, 1878). The printing of a lengthened series of tables, such as that given in the meteorological reports, in which accuracy is absolutely essential to give the report due value, is necessarily a tedious matter, and it is very doubtful whether it will be possible to publish the report for 1877 before the end of the present year. The year was one of continued drought and famine for many months in the Deccan, and of partial drought and threatened famine in Upper India. The meteorology of the year thus presents features of unusual interest. Some remarks on the features of the rains were inserted in the report on the

meteorology of 1876, which has lately been issued. They will be more fully discussed in that for 1877.

13. The Office publications during the year have included a small octavo volume on the meteorology of India, the preparation of which was mentioned in last year's report. It forms the second part of the Indian Meteorologist's Vade Mecum. The object of the work is to inculcate a knowledge of physical meteorology as illustrated in India, and to afford a rational conception of the objects of meteorological observations.

OBSERVATORIES AND THEIR EQUIPMENT.

14. Steady progress has been made in establishing the additional observatories sanctioned by the Government. As noted in the Administration Report for 1876-77, there remained the following stations awaiting their equipment (omitting Shedheshaghur in the Concan and Jessulmere in Rajputana, which it has been resolved to relinquish for the present):

In Rajputana ...	... Bickanir.
In Bombay ...	... Surat. Hyderabad. Rajkot. Malegaon.
In Madras ...	... Mangalore.
In Burma ...	... Thyetmio. Tounghoo. Mergui. Mandalay. Bhamo.

Of the above stations, the following were fully equipped with verified instruments and brought into working condition during the year:—

In Rajputana ...	... Bickanir on the	... 1st September 1877.
In Bombay ...	... Surat ...	... 2nd April 1877.
	Hyderabad, Malegaon	... 19th May 1877.
	Rajkot ...	... 18th June 1877.
And in Burma ...	... Mergui ...	... 1st September 1877.
	Thyetmio, Tounghoo	... 1st November 1877.

The stations in Bombay and Central India have been established by Mr. Chambers. Judging from the daily reports, they appear to be in effective working order, and he deserves praise for the manner in which they have been equipped and brought into operation.

15. In Madras no change has, so far as I can ascertain from the registers, been made during the year. The two stations of Trichinopoly and Bangalore still remain working on the old system, although sanctioned to work as second class observatories.

16. The reduction of the daily readings of the barometers to their sea-level values necessitated by the preparation of the daily weather charts has brought into light cer-

tain discrepancies in the assigned elevations of a few stations, chiefly in the Berars and Central Provinces. The stations of which the elevations are doubtful are Peshawur, in the Punjab, Amraoti, Buldana, Chanda, Sironcha and Saugor, in the Central Provinces and the Berars, and Malegaon in Bombay. Arrangements will be shortly made, if possible, to obtain more accurate and verified determinations of the heights of these stations.

17. The west coast of India is less fully provided with observatories than the coast of the Bay of Bengal. The establishment of an observatory at Mangalore will help to fill up a large gap in the southern part of the west coast, and will give valuable information respecting the advent of the south-west monsoon. As the majority of the Madras stations have not yet been visited and inspected by the Meteorological Reporter to the Government of India, I propose to spend part of the cold weather in that presidency, and shall take that opportunity of establishing the observatory at Mangalore, and, if possible, in immediate connection with the Telegraph Office.

18. The appointment of Mr. R. B. Shaw as Political Agent at Mandalay has been taken advantage of to equip the observatory at that station. It is to Mr. Shaw that we already owe the valuable and excellent observatory at Leh. A full set of instruments in duplicate has been forwarded, and it may be expected that registers will be regularly received from that remote and interesting station in the course of a month or two.

19. The only observatory visited by Mr. Blanford during the past year was Benares. The readings of the barometer at that station were persistently low compared with those of neighbouring stations, and it was suspected that the barometer itself might be at fault. The barometer was, however, found to be in good order, and a comparison showed that the index error was practically identical with what it was when it was sent out from the Allahabad Office to Benares. The low readings of the barometer showed that Benares and its neighbourhood was, during the last year, an area of abnormally low pressure. Mr. Blanford also visited the observatories at Madras, Mussoorce, and Simla, which communicate their registers, but are under independent authority. The Simla Observatory at the Quarter Master General's Office has been furnished with a set of verified instruments to replace the unverified instruments formerly in use.

20. The observatories appear now to work satisfactorily, and under more favourable conditions than in previous years. The instruments employed at the observatories have all been carefully compared with standard instruments, and the observations, taken under similar conditions and in the same manner, are almost, without exception, strictly comparable with each other. The observers have been brought into more rapid and intimate connection with the Central Office as well as with the local Meteorological Offices. An important consequence of this has been a more exact, satisfactory and trustworthy performance of the work of observations.

21. The observatories at Leh and Bushire have continued to furnish valuable observations. For these the Department is indebted to the Government in Ladak and to the Resident at Bushire. The observatory in Beloochistan, sanctioned in February 1877, has been in working order during the greater part of the present year.

22. The system of Meteorological registration under the Indian Government, extends at the present time from 51° to 94½° East Longitude (a range of 43½°)

and from 10° to 34° North Latitude, or if Ceylon be included, from 6° to 34°, a breadth of 28°.

23. *Observatories in Bengal and Assam. The Calcutta Observatory.*—The following extract from the report of the Officiating Meteorological Reporter to the Government of Bengal describes the present condition of the observatory :—

"The observations and favourable anticipations which were made of the working of the Alipore Observatory in the Administration Report of the Reporter to the Government of Bengal for last year have been quite borne out, and the self-recording instruments are now furnishing a complete and continuous record of all the changes of the atmospheric conditions at Calcutta. The work of the observatory now comprises the autographic continuous registration of barometric, thermometric, and hygrometric variations; of the wind direction and velocity, and of the rainfall. The autographic records are checked by readings of the principal instruments four or more times daily. The continuous record of the three first elements, *viz.*, pressure, temperature and humidity, is obtained by photographic processes. These have, on the whole, worked satisfactorily, although it has required a very considerable amount of superintendence during the past year, and has necessitated the continual supervision and personal manipulation of the Reporter."

Besides the observations described in full in the Administration Report for 1876-77, special observations have been made during part of the year for testing the temperature of the air at different levels, and of the temperature of the earth at various distances below the surface.

24. The arrangements described in the last Administration Report for observing the temperature and humidity of the year at a height of 40 feet above the ground were completed in the month of January 1878. Observations have been taken regularly at this height three times a day since that date. After the instruments in this elevation cage had been brought into use, experience showed that the readings of the thermometers were not comparable with similar readings of the instruments situated near the ground in a thatched shed. Every precaution was employed to shield the elevated instruments by an outer cage of tin plate (in part double and with an air space between). It, however, soon became evident that they were affected by radiation in such a manner as to show a greater diurnal range of temperature than the lower instruments. A second cage affording an exposure in all respects similar to that at the top of the palm-tree has been set up at the base of the tree. The double set of observations which are now taken are obtained under exactly similar conditions, and are hence strictly comparable with each other. As might have been anticipated, the instruments in the lower cage at the foot of the tree (at a height of 4 feet above the ground) show a somewhat greater range of temperature than those of the elevated cage (at a height of 40 feet above the ground). When an extensive series of observations have been obtained, they will give valuable information respecting the changes of temperature of the lower atmosphere, a subject on which little or nothing is known in the case of tropical countries.

25. Observations are taken of the temperature of the soil at 10 A.M. and 4 P.M. daily, at the surface, at a depth of 1 foot, and at a depth of 3 feet. These observations belong to a class which have hitherto been comparatively neglected in India. They are useful for determining the conducting power of the soil, and for ascertaining to what depth the surface variations of temperature are felt.

26. Simultaneous observations taken at Alipore and at the Surveyor General's Office in Park Street during the whole of the year 1877, have shown that the temperature of Alipore is considerably lower; and hence the registers of temperature at the new observatory are not directly comparable with those extant for former years. The following table gives the maximum and minimum differences and also the mean difference of the thermometers in the shade at the two observatories:—

Months.	Mean of Maxima.			Mean of Minima.			Mean Temperature.		
	S. G. O.	Alipore.	Difference.	S. G. O.	Alipore.	Difference.	S. G. O.	Alipore.	Difference.
April 1877	91·8	92·2	+0·4	76·6	73·4	—3·2	82·6	79·8	—2·8
May „	94·7	95·9	+1·2	79·5	77·0	—2·5	85·9	82·8	—3·1
June „	91·6	91·8	+0·2	80·9	78·5	—2·4	85·4	82·6	—2·8
July „	88·8	88·8	0	80·1	78·0	—2·1	83·2	81·8	—1·4
August „	87·6	88·1	+0·5	80·1	78·5	—1·6	82·7	81·5	—1·2
September „	89·0	88·7	—0·3	80·5	78·3	—2·2	83·8	82·3	—1·5
October „	88·1	87·8	—0·3	77·3	74·2	—3·1	81·9	79·1	—2·8
November „	84·7	84·2	—0·5	70·9	65·9	—5·0	77·1	74·0	—3·1
December „	78·4	78·5	+0·1	62·8	57·8	—5·0	69·6	66·9	—2·7
January 1878	75·8	76·6	+0·8	59·9	55·4	—4·5	67·0	64·6	—2·4
February „	84·9	84·5	—0·4	68·9	64·3	—4·6	76·1	73·4	—2·7
March „	91·1	91·2	+0·1	73·4	70·0	—3·4	81·0	78·5	—2·5

It may be desirable, if not necessary, to continue the temperature observations at the Surveyor General's Office for another year in order to determine the average difference for each month, so as to enable the present observations to be immediately comparable with those of former years, and thus preserve continuity in the record of the temperature at Calcutta.

27. It was decided some time ago that the arrangements for dropping the Time Ball to give local time to the shipping at the port of Calcutta, should be transferred from the Surveyor General's Office in Park Street to the Alipore Observatory. Plans for a transit room at Alipore were prepared and approved last year, and the Public Works Department commenced the erection of the building in January 1878, on a site in a quiet, convenient position, adjoining the observatory building. The building at first progressed satisfactorily, but latterly the delay in supplying the iron work necessary for the shutters has retarded progress very considerably, and it is now very doubtful whether it will be ready for use before the setting in of the rains. This unfortunate delay will probably prevent the transfer of the Time Ball Office to Alipore until the end of the rains. Meanwhile the Surveyor General has kindly consented either to carry on the work, or to grant the Meteorological Department the use of the Time Ball Office and instruments at the Park Street Observatory.

The future Chief Observer is learning his work under the Superintendent of the Time Ball Office at the Surveyor General's Office, and is already quite qualified to undertake his new duties.

28. The staff employed at the Alipore Observatory now consists of two photographic assistants, each receiving Rs. 40 per mensem, and of two observers receiving a salary of Rs. 20, and in addition a ghari allowance of Rs. 8 per month. One of the photographic assistants also receives a residence allowance of Rs. 10 per mensem. This arrangement is at present working satisfactorily. During the year it was found necessary to make some changes in the staff. The photographic assistant in charge at the end of the last financial year shortly afterwards resigned his post. His successor was a tabulator in the Office of the Meteorological Reporter to the Government of India. He worked very satisfactorily for a few months, but could not withstand the temptations afforded by the payment of small sums for the contingent expenses of the observatory. He was detected and immediately afterwards dismissed.

29. *Other Observatories in Bengal and Assam.*—The changes in the working of the observatories have been very slight. False Point, which has been hitherto a second class station, was converted into a third class station from the 24th of October, and the observatory removed from the Light-house to the Telegraph Office. Daily telegrams are now sent from this important station to Calcutta in connection with the storm-warning system established in 1871. There are now under the Meteorological Reporter to the Government of Bengal, seven stations of the second class at which three sets of observations are taken daily at 10 and 16 hours local time and at 7-35 A.M., Washington mean time. In addition, hourly observations are taken on four days of each month. At Saugor Island, a very important sea-board station in relation to Calcutta, six-hourly observations are obtained.

30. Mr. Pedler reports that these stations are all in fairly satisfactory order, and that the observations are made with great care and attention, and that very accurate results are obtained. For some time after the commencement of the year, Chittagong again gave some trouble, and the registers came to hand very irregularly. The telegraph master, who also acts as meteorological observer, alleged that the work was increasing, and that it interfered with his other more important duties. In order to meet this difficulty, the three telegraph masters at second class stations, Chittagong, Cuttack, and Saugor Island, have been requested to send in their observations unreduced instead of reduced as hitherto. This arrangement came into force in January last, and since that date the transmission of the registers has become much more regular. The work of reduction of the observations sent from these three stations is now performed in the Central Office. Great care also appears to be exercised by the observers at second class stations in the use of the instruments, entrusted to their charge, and very few replacements have been made during the year.

31. There are now twelve third class stations under the Meteorological Reporter to the Government of Bengal; one of these, Akyab, is in British Burma, and another, Silchar, in Assam. Demagree, in the Chittagong Hill Tracts, has been added during this year. This station was established and equipped under the new rules for the regulation of the issue of meteorological instruments made by the Government of India in May 1876.

32. Mr. Pedler states that the third class stations are in fairly satisfactory order, but some of the observers still show a want of care and attention in making their observations and sending their reports. At the majority of stations, the mistakes have not been numerous or serious, but Durbhanga, Gya and Purneah have attained an unenviable

notoriety for the careless way in which their reports are submitted. It was found necessary at the close of last financial year to dispense with the services of the Jessore observer. A man trained at the Alipore Observatory was appointed in his place, and the observations at that station are now satisfactory.

33. The observers at the third class stations appear to be more careless in the use of their instruments than those of the second class. Breakages of instruments have been three times more numerous in the former class than in the latter.

34. The following is the list of second and third class observing stations, with the names of the Observers and Superintendents during the year:—

Stations.	Class.	Superintendents.	Observers.
Cuttack ...	Second	.....	Mr. F. C. Smith *and an assistant.*
Chittagong ...	„	... .	„ J. Burke *and an assistant.*
Saugor Island ...	„	... ...	„ R. H. Peters.
Goalpara ...	„	Dr. J. Cromarty [1]	Muniruddin Ahmed *and an assistant.*
		„ W. J. Mountain [2]	
Sibsagar ...	„	„ R. C. Seu [3]	Dandadhar Dutta Barua *and an assistant.*
		„ M. Mookerjee [4]	
Patna ...	„	„ B. Simpson [5]	Moonshee Mohabat Lall *and an assistant.*
		„ Bully Chunder Sen [6]	
		„ R. Bird [7]	
Hazaribagh ...	„	„ E. Birch	Raheemoolla *and an assistant.*
False Point ...	Third	... ...	Mr. T. Geary. [8] „ E. Workman. [9] „ H. Walley [10]
Akyab ...	„	... ...	Mr. T. J Bennett.
Jessore ...	„	Dr. R. T. Wright [11]	Babu Dwarka Nath Roy. [15]
		„ Ratty Kant Ghosh [12]	„ Poresh Nath Roychowdhry. [16]
		„ G. Price [13]	
		„ A. E. R. Stephens [14]	
Dacca ...	„	....	Mr. J. Collett. [17] „ E. W. Shave. [18]
Burdwan ...	„	Dr. J. A. Green [19]	Babu Mokhodapersad Chowdry.
		„ R. Cobb [20]	
		„ L. Cameron [21]	
		„ R. Bird [22]	
Silchar ...	„	„ G. A. Warburton	Babu Romesh Chunder Bhadra. [23]
			„ Behary Lall Dhar. [24]
Berhampore ...	„	„ S. M. Shircore	„ Mohendra Nath Roy.
Gya ...	„	„ L. Cameron [25]	Nowrungee Lall. [28] Babu Sheddessur Banerjee. [29]
		„ Kristo Chunder Basu [26]	
		„ W. F. Murray [27]	
Darjeeling ...	„	.....	Mr. J. Blong.
Purneah ...	„	Dr. D. Picachy	Babu Kumad Behary Samonto.
Durbhanga ...	„	„ J. C. McDonnell	Not known.
Demagree ...	„	....	Babu Nemy Churn Chatterjee. [30] „ Debendra Nath Guho. [31]

[1] To November 1877.
[2] Since December 1877.
[3] To November 1877.
[4] Since December 1877.
[5] To December 1877.
[6] January and February 1878.
[7] March 1878.
[8] April 1877.
[9] May to 24th October 1877.
[10] Since 25th October 1877.
[11] To June 1877.
[12] July and November 1877.
[13] August to October 1877 and March 1878.
[14] December 1877 to February 1878.
[15] To 14th May 1877.
[16] Since 15th May 1877.
[17] April and May 1877.
[18] Since June 1877.
[19] April 1877.
[20] May to September 1877.
[21] October to December 1877 and March 1878.
[22] January and February 1878.
[23] To 10th September, and since 8th November 1877.
[24] 11th September to 7th November 1877.
[25] To 23rd September 1877.
[26] 24th September to 23rd October 1877.
[27] Since 24th October 1877.
[28] To 23rd May, and since 1st December 1877.
[29] 24th May to 30th November 1877.
[30] To 6th September 1877.
[31] Since 7th September 1877.

35. Rainfall returns have been received during the year from 150 stations in Bengal and four in Assam. Registers have also been furnished regularly by Mr. J. M. L. Thomson of Contai. Dr. Foster sent rainfall returns from six tea gardens in Assam until his departure from India last January, and Mr. J. C. Vertannes sent returns from Balasore until August last.

36. Two stations were visited by the Reporter during the year—Durbanga and False Point. The barometer at Durbhanga when reduced to sea-level for the daily charts was found to be persistently low. As the Superintendent could not account for it, it became necessary to visit the station. The instrument was then ascertained to be defective owing to the pressure of a small quantity of air in the tube. Another barometer was at once sent to this observatory. It was found in other respects to be in good working order. False Point was inspected after the transfer of the observatory to the telegraph office. The observatory is only a temporary one, as it will probably be necessary to move it with the telegraph office which is stated to be in an unfavourable position. It was found to be in a satisfactory condition.

37. OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH. During the past year there has been no change either in the number of the observatories or the method of observations carried on, excepting the additional synoptic observations taken at the second class stations since June 1877.

38. The two observatories at Dehra and Meerut under independent management have continued to furnish registers during the past year. In all fourteen stations have contributed registers to the Reporter of the North-Western Provinces and Oudh during the year. Four of these are second class stations.

39. Allahabad has continued to work as a second class station, although sanctioned as a first class. The autographic instruments (Von Rysselberghe's meteorographs) will probably not arrive for some months longer. The cause of the delay in the despatch of these instruments from England has not yet been ascertained. Meanwhile two additional eye observations of the ordinary instruments are recorded daily at this station, *viz.*, 4 A.M. and 10 P.M.

40. The following is a list of the observatories of all classes in the North-Western Provinces and Oudh during the year 1877, with the names of the Superintendents and Observers during the year :—

Stations.	Class.	Superintendents.	Observers.
Chakrata ...	Third	J. B. Bromley, Esq., C. E.[1]	Saligram.
		Major Blair[2]	Kunden Lal.[4]
		J. B. Bromley, Esq., C. E.[3] ...	Saligram.
Ranikhet ...	„ ...	...	Jeswanand.
Roorkee ...	Second	Dr. Murray Thomson	... ...
		„ R. Blood[5]	Chiranji Lal, *with an assistant.*
		„ Murray Thomson	...
Meerut ...	Third ...	Dr. W. Moir	Harsaran Dass.
Bareilly ...	„ ...	E. S. Phillips, Esq.	Jwala Parshad.
Agra ...	Second ...	Dr. A. H. Hilson	Mir Altaf Ali, *with an assistant.*
Lucknow ...	„	Dr. E. Bonavia	Chotay Lal, *with an assistant.*
		„ J. C. Whishaw[6]	
Allahabad ...	„ ...	S. A. Hill, Esq., B. S. C.	Babu Kedar Nath Chatterjee, *with an assistant.*
Gorakhpur ...	Third	Dr. A. Wood	Mahomed Shaikh.
		„ C. Prentis[7]	Kali Basant Suty.
Benares ...	„	R. T. H. Griffith, Esq.	Babu Devakinandan Pattak.
		A. E. Gough, Esq.	
Jhansi ...	„	Dr. B. O'Brien	Kalka Das.
		„ H. J. Linton[8]	
		„ B. O'Brien	
Ajmere ...	„ ...	Dr. T. Murray	Ram Parsad.
Sutna ...	„ ...	„ S. J. Goldsmith	Harnath.

[1] To October 1877.
[2] From November 1877 to February 1878.
[3] Since March 1878.
[4] September and October 1877 only.
[5] In September 1877 only.
[6] From 19th December 1877.
[7] From March 1878.
[8] From 16th June to 31st October 1877.

41. Mr. Hill reports that the observatories at Dehra, Bareilly, Lucknow, Allahabad, Sutna and Benares maintain a high character for accuracy. Chakrata has greatly improved since last year, and the returns from Jhansi, Meerut, and Ajmere are also fairly good this year. The observations taken at Agra appear to be perfectly honest, but owing to frequent inaccuracies in the arithmetical work of the observer, the reduced registers sent into the Allahabad Office have had to be entirely recalculated. This had also to be done with the returns of another second class station, Roorkee, and on more than one occasion, notably in September, many of the observations from this station, both daily and hourly, appear to have been forged. In consequence of this, and notwithstanding Dr. Murray Thomson's testimony as to the good character of the observer, Chiranji Lall, Mr. Hill had to threaten him with immediate dismissal in case of any doubtful observations in future. After this the observations were taken with much greater care. The temperature observations taken at Gorakhpur during all the hot weather months from April to September appear to be entirely untrustworthy, though the barometric observations are fairly good. The only explanation of this that Mr. Hill can suggest is that the observer, Assistant-Surgeon Mahomed Shaikh, did not care to go out into the heat, particularly at 4 P.M., to look at the thermometers, though he had no objection to taking an honest reading of the barometer, since the latter instrument was in a room inside the dispensary where he worked. In consequence of the very unsatisfactory nature of some of the observations in May, Mr. Hill suggested to the Superintendent, Dr. Wood, that the observer should be fined to the amount of his month's pay. Nothing was done at the time, however, and in June and July the observations improved somewhat, but again in September they became hopelessly bad, and a new observer had to be appointed. The new man, Kali Basant, is the Civil Surgeon's clerk, and since his appointment he has worked very well.

At the remaining station, Ranikhet, the observer has worked as well as could be expected, seeing that there is no local superintendent, but on more than one occasion some of the temperature observations have been of doubtful accuracy.

42. Mr. Hill inspected the observatories at Meerut, Chakrata, Sutna, Agra, Jhansi, Lucknow, Gorakhpur and Benares. They were generally found in good order. The portion of his report which described the condition of the observatories he visited is given in Appendix I, page 28.

43. OBSERVATORIES IN THE PUNJAB. There have been no changes in the observatories of the Punjab during the past year. Lahore still continues to work as a second class observatory. The autographic instruments have not yet been despatched from England. There is no other second class station in the province. Leh, in the Cashmir territory, has continued to work as a second class station, and communicates its registers regularly to the Punjab Reporter.

44. The following is a list of the stations and of the Superintendents and Observers during the past official year:—

Stations.	Class.	Superintendents.	Observers.
Peshawur ...	Third...	Dr. S. C. Courtney ...	Kashi Ram. Abdool Jabbar.[1]
Murree ...	„	Revd. J. C. Peak ...	Mr. R. Johnson.
Rawalpindi ...	„	Dr. G. Henderson ...	Bhawani Dass. Fatteh Chand.[2]
Sialkot ...	„	„ R. Cunningham ...	Fatteh Singh.
Lahore ...	Second	„ A. Neil ...	Jasput Rai. Divanchand (*Assistant Observer*).
Ludhiana ...	Third...	„ R. Rouse ...	Mirza Ameer Beg.
Delhi ...	„	„ J. Fairweather ...	Radha Kissen. Ram Kissen.[3]
Dera Ismail Khan	„	Dr. J. Duke[4] ... „ T. Robinson[5] ... „ J. Duke[6] ... „ G. Davis ...	Noor Bukhsh. Ameerchand.[7]
Mooltan ...	„	Dr. J. C. Penney ...	Vahed Ally Shah.
Sirsa ...	„	„ J. Rehill ...	Fazalon Rahman.
Leh, Ladak ...	„ *	Mr. W. Jenkyns[8] ... „ N. Elias[9] ...	Charg Divi. Bholanath (*Assistant Observer*).

[1] From 13th August to 30th September 1877.
[2] From 17th August to 16th October 1877.
[3] From 11th to 31st March 1878.
[4] To 18th July 1877.
[5] From 19th July to 15th October 1877.
[6] From 16th October 1877 to 4th March 1878.
[7] From 2nd June to 17th July 1878.
[8] From 2nd July to 29th October 1877.
[9] Since 12th December 1877.

* There was no Superintendent at Leh from 1st April to 2nd July and from 30th October to 14th December 1877.

45. Dr. Neil reports that there has been a marked improvement in the character of the observations which have been supplied monthly, and all the stations are in excellent order. He also adds that the Mooltan Observer required an occasional reminder. I am glad to be able to confirm Dr. Neil's statement of the general improvement of the Punjab observatories. The Mooltan Observatory is important from its position, and if the Observer does not improve, it will be necessary either to replace him or to remove the Observatory and place it in connection with the Telegraph Office.

46. During the past year Dera Ismail Khan and Mooltan were visited by a trained assistant. The work of inspection of observatories by the local reporter is very important in order to ascertain that the sheds are in proper condition and that the instruments are in good order and properly suspended, and also to keep up, by personal visits, the interest of the observer in his work. I hope during the next cold weather to visit some of the Punjab stations in continuance of Mr. Blanford's tour of inspection of the year 1876.

47. OBSERVATORIESIN BOMBAY, RAJPUTANA, CENTRAL INDIA, AND BERAR (IN WESTERN INDIA). During the year under report the work of establishing additional observatories in Western India has been steadily advancing towards completion. Meteorological observations were commenced at the undermentioned stations on the dates specified:—

Surat	...	...	...	...	...	2nd April 1877.
Hyderabad	...	...	...	...	...	19th May „
Malegaon	...	...	...	...	...	19th May „
Rajkot	...	...	...	...	...	18th June „
Bikanir	...	...	...	...	...	1st September „

Voluriteer observatories were also established at Satara and Karwar.

48. The station at Karwar supplies an important defect. Coast and hill stations are very important for giving indications of approaching weather. The Bombay coast is unfortunately not so well supplied with meteorological stations as the Bay of Bengal. A series of stations at nearly equal distances along the coast to give indications of the advent of the south-west monsoon along the Bombay coast and of the approach of bad weather to the west of Bombay, seems to be an important desideratum.

49. All the observatories originally proposed for Western India, with the exception of the one for Jesulmere, have now been established. With regard to this station it has been found impossible to carry out the original proposals, as no Government Office whatever exists there. The Maha Rawul of Jesulmere has given his consent to the establishment of an observatory in his capital, and the project would become feasible if a special observer having no other duties to perform were employed.

50. The following is a list of the stations and of the Superintendents and Observers during the past official year :—

Stations.	Class.	Superintendents.	Observers.
Jacobabad ...	Third ...	Surgeon S. H. Banks	Hurree Bhawoo.
Bickanir ...	,, ...	.....	Ram Ball.
Sattara ...	,, ...	Mr. W. Strachan, Superintendent of Cotton Experiments.	Office Clerk.
Hyderabad (Sind) ...	,,	Surgeon-Major R. O. Heyden [1]	Corporal Balls.[4]
		,, S. B. Halliday [2]	,, C. Randel.[5]
		,, W. L. Farmer [3]	
Kurrachee ...	Second ...	,, A. R. Hudson ...	E. Cardwell.
Bhuj ...	Third ...	,, P. W. Cockell ...	Narayen Manay.
Deesa ...	Second ...	,, ——Moffit	A. R. Rodrigue.[6] James Bruce.[7]
Mount Abu ...	Third	,, D. O'Donovan [8]	A. Mullen.[9]
		,, A. Moffitt [10]	J. Briggs.[11]
		,, J. Greig [12] ...	T. Buchoo.
		,, W. Donovan. [13]	
		,, H. Waghorn.[14]	
Neemuch ...	,,	,, T. Boyd. [15]	
		,, H. Waghorn.[16]	
		,, T. Boyd.[17]	
		,, H. Waghorn.[18]	
Indore ...	,,	Dr. D. F. Keegan [19]	Ganpat Singh.
		,, R. Caldecot.[20]	
		,, D. F. Keegan.[21]	
Rajkot ...	,,	Surgeon W. A. Barren [22]	Shaik Dadu.
		,, J. Parker.[23]	
		,, R. H. Batty.[24]	
		,, J. Parker.[25]	
Surat ...	,,	Surgeon-Major C. Joynt [26]	Ballao Khundoo.
		,, G. F. H. Brown.[27]	
		Surgeon F. C. Barker.[28]	
		,, O. H. Channer.[29]	
		Surgeon-Major G. F. H. Brown.[30]	

[1] From 19th May to 27th December 1877.
[2] From 28th to 31st December 1877.
[3] Since 1st January 1878.
[4] From 19th May to 16th October 1877.
[5] Since 17th October 1877.
[6] From 1st to 7th April 1877.
[7] Since 8th April 1877.
[8] From 1st April 1877 to 25th March 1878.
[9] From 1st April to 15th May 1877.
[10] Since 26th March 1878.
[11] Since 16th May 1877.
[12] From 8th April to 31st May 1877.
[13] From 1st June to 15th July 1877.
[14] From 16th July to 7th December 1877.
[15] From 8th to 15th December 1877.
[16] From 16th December 1877 to 22nd January 1878.
[17] From 23rd January to 8th February 1878.
[18] Since 9th February 1878.
[19] From 1st April to 30th July 1877.
[20] From 31st July to 13th October 1877.
[21] Since 14th October 1877.
[22] From 18th June to 18th October 1877.
[23] From 19th October to 21st December 1877.
[24] From 22nd December 1877 to 9th February 1878.
[25] Since 10th February 1878.
[26] From 1st to 11th April 1877.
[27] From 12th April to 21st May 1877.
[28] From 22nd to 29th May 1877.
[29] From 30th May to 29th November 1877.
[30] Since 30th November 1877.

Stations.	Class.	Superintendents.	Observers.
Akola ...	Third ...	Dr. Charles Little ...	Samuel Gregory.
Amraoti ...	"	" J. S. Howard [31] / Apothecary J. Reid [33]	Sakharam Pandoorang.[32] / Mahomed Booran.[34]
Chikulda ...	" ...	No Superintendent ...	Ameencola Khan.
Buldana ...	" ...	Dr. A. R. Menasse ...	Pandoorang Kristnajee.
Malegaon ...	" ...	Surgeon-Major W. D. Ticehurst ...	Bhagoo Mahadoo.
Poona ...	Second ...	B. Bustand ...	B. Devery.
Sholapur ...	Third	Surgeon Boyd [35] / " N. Bowman.[36]	Bulwantrao Nilkunt.
Ratnagiri ...	"	" J. W. Clarkson [37] / Surgeon-Major C. Joynt.[38]	Mahadeo Cuddum.
Belgaum ...	Second ...	" B. E. Griand ...	G. A. Newman.
Karwar ...	Third ...	R. G. C. Westbrook, Esq. ...	Post Office Clerk.

[31] From 1st April 1877 to 19th March 1878.
[32] From 1st April 1877 to 12th March 1878.
[33] Since 20th March 1878.
[34] Since 13th March 1878.
[35] From 1st April to 24th May 1877.
[36] Since 25th May 1877.
[37] From 1st April 1877 to 17th February 1878.
[38] Since 18th February 1878.

51. Mr. Chambers also reports that the registers for the year 1877 from all observatories that were in working order in the begininng of that year have been, on the whole, very satisfactory. The Chikulda and Buldana registers, which were very unsatisfactory in many respects during the previous year 1876, have shown in 1877, as anticipated, a very marked improvement. Indeed the Buldana registers are now one of the best, whilst those of Chikulda were only defective in April, when the regular observer was absent from the station. As might have been expected, the registers from some of the newly established observatories have, from want of experience on the part of the observers, occasionally been defective. The main difficulty that had to be contended with was that of keeping the wet bulb thermometers in proper order, particularly at the new inland observatories, during the hot weather months, April, May and June. The registers from Jacobabad, Bickanir, Hyderabad, Neemuch and Malegaon have in this respect been to some extent defective. Those from Rajkot, Surat, Sholapur and Ratnagiri have been almost free from this source of error. At Bickanir the observer was altogether untrained, and the barometric observations for the first three months are worthless, whilst at Rajkot and Sholapur the barometric observations for a similar period are decidedly inferior in quality; with these exceptions the observations have evidently been made with care. It is also satisfactory to be able to report that the inter-comparison of the observations from different stations shows clearly that no systematic falsification of registers has been practised by any of the observers: mistakes have of course been made, but these have, Mr. Chambers believes, in almost all cases, been detected and corrected, and brought to the notice of the observers for their future guidance.

52. Mr. Chambers visited several of the stations in Western India during the course of the year. His description of the observatories, and of the condition in which he found them, is given in full in Appendix B, page 29.

53. OBSERVATORIES IN THE CENTRAL PROVINCES. The number of observatories have remained unchanged during the past year. The province is now fairly well represented in the meteorological system. Judging from the daily reports sent in, the second class observatories, Nagpur, Jubbulpore and Pachmarhi, continue to work very satisfactorily.

The third class stations are not quite so satisfactory. Khandwa and Hoshangabad continue to work well. The comparison of the daily readings of the remaining stations occasionally suggest large discrepancies. Unfortunately the meteorology of the most easterly part of the Central Provinces and the southern portion of Chutia Nagpur is yet almost unknown, and the elevations of several of the stations so doubtful as to make the work of comparison difficult and unreliable. I hope the cold weather will afford me sufficient leisure to visit these stations and to place them on a more satisfactory footing. Their great distance from any railway renders them at present almost inaccessible to the officers of the Meteorological Department.

54. The following is a list of the stations, with the names of the Superintending Officers and Observers:—

Stations.	Class.	Superintendents.	Observers.
Nagpur ...	Second	Surgeon-Major J. Barter[1]	T. V. Vurtharajooloo.
		,, ,, J. Brake[2]	T. V. Allagheriswamy (*Assistant*).
		,, ,, J. Barter[3]	
Jubbulpore ...	,,	Surgeon-Major W. R. Rice	Kadir Khan[4] *with an assistant.*
			Babu Prosono Cumar Basu.[5]
Pachmarhi ...	,,	Captain F. B. Morris	Madho Rao.
			Narain Bhugwant Wagby (*Assistant*).
Saugor ...	Third	Surgeon D. F. Bateman	Deen Dyal.
Hoshangabad ...	,,	,, H. N. Leckler	Vasudeva Prasad Narain.
Khandwa ...	,,	Surgeon-Major P. Cullen	Raja Ram.
Seoni ...	,,	Surgeon B. Evers[6]	
		Hospital Asst., Sheik Shubrati[7] ...	Punchumi.
		Surgeon S. H. Browne[8]	
Chanda ...	,,	Apothecary N. Craggs	Seeta Ram.
Raipur ...	,,	Surgeon-Major D. W. Trimmel[9] ...	Krishen Rao.
		Surgeon C. Lloyd[10]	
Sambalpur ...	,,	Honorary Surgeon J. E. Harrison ...	Samsunder Dass.
			Ragavaloo Naidoo.[11]
Sironcha* ...	,,	Surgeon J. B. Gaffney ...	Buldeo Ram Sing.[12]
			Mohun Lal.[13]

[1] To 18th June 1877.
[2] From 19th June to 14th November 1877.
[3] Since 15th November 1877.
[4] To 31st May 1877.
[5] Since 1st June 1877.
[6] To 25th September 1877.
[7] From 26th September to 19th November 1877.
[8] Since 20th November 1877.
[9] To 26th March 1878.
[10] Since 27th March 1878.
[11] To 31st July 1877.
[12] From 1st August to 2nd October 1877.
[13] Since 8th November 1877.

* No Observer was employed at this station between 2nd October and 8th November 1877.

55. OBSERVATORIES IN MADRAS. No report has been received from the Meteorological Reporter of the stations under his charge. I can only repeat Mr. Blanford's opinion of last year, that the registers bear internal evidence of careful and accurate observation at the majority of stations. No change has yet been made in the arrangements at the two stations which were sanctioned to work as second class observatories. As I have reason to believe that Mr. Pogson's onerous duties as Government Astronomer prevents his inspecting these observatories, I hope to find time to visit the majority of them during the cold weather and to establish the observatory sanctioned at Mangalore.

56. OBSERVATORIES AT THE ANDAMANS AND NICOBARS. No change has been made in these two valuable observatories during the year, and they continue to furnish care-

fully-kept and accurate registers. The names of the Superintendents and Observers are as follow :—

Stations.	Superintendent.	Observer.
Port Blair Nancowry	Surgeon-Major J. Dougal, M. D. ...	Mr. F. J. Carrick. „ J. Peters.

57. OBSERVATORIES IN BURMA. The stations in working order at the beginning of the official year were Akyab, Rangoon, Bassein and Moulmein. These stations have furnished observations for the whole year. There were, as Mr. Blanford pointed out in last year's Administration Report, remarkable differences of pressure between these stations. Prolonged observation will be necessary to shew whether they are permanent, or simply abnormal variations of unusually long continuance. Rangoon contributes very satisfactory and trustworthy observations. A Beckley's anemograph has been erected on the roof of the High School, and appears to have commenced the work of continuous observation in a satisfactory manner.

58. The opening of a telegraph station at Diamond Island was taken advantage of to push the storm-warning system one step further along the east coast of the Bay. Carefully verified instruments were despatched in November 1877, observations began to be taken in the month of February 1878, and daily telegrams of the 10 A.M. readings are furnished to the Meteorological Reporter to the Government of Bengal for comparison with the readings at the other telegraphic reporting stations of the Calcutta storm-warning system round the coast of the Bay of Bengal.

59. The sanctioned observatories at Tounghoo, Thyetmio and Mergui were also opened during the year in the months of September and November 1877.

60. The list of the stations, with the names of the Superintendents and Observers, are as follows :—

Stations.	Class.	Superintendents.	Observers.
Thyetmio ...	Third...	Dr. T. Croudace[1] ... „ Oswald Baker[2]	Ahmed Ally.
Tounghoo ...	„	Surgeon Spencer ... Dr. R. V. Power ...	Solomon.[3] Indurmun.[4] Paul.[5]
Bassein ...	„	Dr. C. W. E. Foster	Ab'lool Hossain. Ismail. Asiff Pyaman.
Rangoon ...	Second	Dr. Oswald Baker[6] „ G. A. Dundas[7]	A. G. Campagnac.[8] W. Marshall.[9] C. Phillips[10] (*Assistant Observer*) R. Donald[11] (*Assistant Observer*).
Moulmein ...	Third...	Dr. W. F. Defabeck	Moobark k Ally.
Mergui ...	„	Dr. R. S. Dawson ...	Chand Khan.[12] Moung Shoay Stloon.[13]

[1] To 10th October 1877.
[2] Since 11th October 1877.
[3] From 9th January 1878.
[4] From 18th February 1878.
[5] From 19th February 1878.
[6] From March 1877.
[7] From June 1877.
[8] To September 1877.
[9] Since October 1877.
[10] To January 1878.
[11] Since February 1878.
[12] To September 1877.
[13] Since October 1877.

61. EXTRA INDIAN OBSERVATORIES. The observatory established at Bushire under the direction of Colonel Ross, Her Majesty's Resident at that town, has continued to furnish interesting registers. The important observatory at Leh also sends observations regularly. The observatory at this town, from its peculiar position in the heart of the Himalayas, and situated at a height of about 11,000 feet above sea-level, will probably be found to deserve separate discussion.

62. The observatory for Quetta in Beluchistan sanctioned last year was equipped with verified instruments from Calcutta in July 1877. The Medical Officer, Dr. Duke, takes great interest in the work of observation. The difficulty of transporting instruments to so distant a continental station has delayed the complete equipment of the station. It is situated in the midst of a tract which largely influences the meteorology of Upper India. The observations will, therefore, probably be peculiarly valuable, and throw much light on the atmospheric changes of Upper India more especially during the six months of the prevalence of the north-east monsoon in India.

63. The observatories sanctioned for Mandalay and Bhamo will shortly be opened under the general supervision of Mr. Shaw, as already stated in paragraph 7.

64. METHODS OF OBSERVATION. No change has been made in the methods of observation during the past year.

65. SUMMARY. There were, on the 31st March 1878, 103 observatories at work in India and its dependencies (excluding Ceylon), and one in the Persian Gulf. Of these, 89 were under the direction of the Meteorological Department, and 14, either private or independent, under other Departments or volunteers. All, except the private observatories, are furnished with barometers and thermometers, which have been carefully verified, and the readings of which can be corrected to those of the well-known standards in India or in Europe. The elevations of by far the greater number of the barometers are now known with great accuracy. A few in the more remote districts remain of doubtful accuracy. The exposure of the instruments is, so far as it is possible, uniform at all stations. All the observatories take readings at 10 A.M. and 4 P.M. Hourly readings on four days in each month are recorded at sixteen stations carefully selected over Northern India and Burma, and on one day of each month at four stations in Western India. The stations have been brought into close connection with the Central Office by the transmission of the 10 A.M. readings daily by post, and the preparation of the daily charts from these postal returns by the Central Office is already beginning to throw light on the connection between the seasonal and daily atmospheric changes over the whole of India.

METEOROLOGICAL OFFICERS AND OFFICE WORK.

66. The *personnel* of the superintending staff was as follows on the 31st March 1878:—

Province.	Superintending Officers.	Names.
Bengal and Assam	Meteorological Reporter to the Government of Bengal	J. Eliot, Esq., M. A.
North-Western Provinces and Oudh	Meteorological Reporter to the Government of North-Western Provinces and Oudh	S. A. Hill, Esq., B. Sc.
Punjab	Meteorological Reporter to the Government of Punjab	Dr. A. Neil, M. D.
Bombay, Rajpootana and Central India	Meteorological Reporter for Bombay, Rajpootana, &c.	F. Chambers, Esq.
Berar	Sanitary Commissioner	Dr. Abbott.
	Meteorological Reporter for Bombay, &c. ...	F. Chambers, Esq.
Central Provinces ...	Sanitary Commissioner	Dr. J. Brake.
	Meteorological Reporter to the Government of India	H. F. Blanford, Esq.
Madras	Meteorological Reporter to the Government of Madras	N. R. Pogson, Esq.
Andaman Settlements ...	Chief Medical Officer	Dr. J. Dougall, M. D.
	Meteorological Reporter to the Government of India	H. F. Blanford, Esq.
Burma	Sanitary Commissioner	Dr. Kelly.
	Meteorological Reporter to the Government of India	H. F. Blanford, Esq.

67. The transmission of the registers has been considerably accelerated during the past year. The Bombay returns reach the Central Office with great quickness and regularity. Bengal, the North-Western Provinces and Punjab also furnish the reduced returns with considerable regularity. The pressure of work is, however, becoming yearly greater, and the Reporters of Bombay, the Punjab and the North-Western Provinces have all referred to the necessity for some extension of their respective offices. Hitherto the work of the Department has been confined to the collection of the observations and their subsequent discussion. A delay of a month or two necessary to accumulate the whole of the information from the more distant observing stations, or the more dilatory of the observers, was a matter of no great importance. But now, with the utilization of the daily postal and telegraphic service, greater rapidity in the collection and reduction of the observations becomes a matter of necessity. The complete materials for discussing the meteorology of any month in India are, under present arrangements, fully three months in arrear. If the observations of the period antecedent to the south-west monsoon are to be utilized in future years for the forecasting of the character of the approaching rain monsoon, some slight extension of the respective offices will be absolutely necessary in order that the meteorological returns may be prepared with due rapidity. The *raison d'etre* of the Meteorological Department as a Government Department seems to be to provide, as early as possible, accurate information of the meteorology of the country for the use of the Government. This implies a knowledge of the present as well as of past meteorology—the former for present information, the latter for comparison and guidance in prevision.

68. The general work of reduction in the Central Office has been further facilitated during the year by the preparation of special tables for the reduction of the observed barometric heights to the sea-level.

69. The work of the local Meteorological Reporters' offices has consisted chiefly in making the primary corrections and reductions of the registers of the observations in their respective provinces. Mr. S. A. Hill, Mr. Pogson, Mr. Chambers and the Meteorological Reporter to the Government of Bengal furnish monthly summaries for the respective provincial gazettes. Dr. Neil, Meteorological Reporter to the Government of

Punjab, discontinued them after the reorganization of the Department. He intends, in view of the general interest taken in meteorology, to recommence the publication of the monthly abstracts of the observations taken in the Punjab in the local Gazette.

70. Mr. Chambers has not yet furnished the discussion of the wind registers at Kurrachee for the reasons given in paragraph 22 of his report, given in Appendix B. From the difficulty of obtaining thoroughly intelligible and thoughtful native assistance, much of the work, which in European Meteorological Offices is done by the higher clerks, is necessarily done in this country by the Reporters themselves. This peculiar difficulty in India very considerably diminishes the time at the disposal of the officers for independent investigation and for the general consideration of Indian meteorological problems. Mr. S. A. Hill has prepared a paper, in continuation and extension of his paper on the winds and rainfall of Benares, published in the 2nd part of the Indian Meteorological Memoirs. In it he discusses the inverse relation subsisting between the summer and winter rainfall of Upper India, and the connection between the rainfall and temperature of India and the sun-spot period. The paper will, I hope, be included in the 3rd part of the Meteorological Memoirs, the preparation of which has already commenced. During the year I prepared an account of the Madras cyclone of May 1877. This was commenced with the object of ascertaining whether the principles established from an examination of the Backergunge cyclone would explain the phenomena of the Madras cyclone. As the investigation seems not only to confirm the conclusions established in the Report on that cyclone, but also appears to throw some additional light on cyclone motion, it will also be published in the 3rd part of the Indian Meteorological Memoirs.

71. The Office has continued to work very satisfactorily. The Head Clerk, Babu Fanindra Mohan Basu, deserves much commendation for the manner in which he has extended the Office during the year, and enabled it to meet the additional work thrown upon it by the introduction of the daily postal weather system. The Head Computer, Babu Brojo Mohan Ruckit, and the Head Draughtsman, Babu Khetra Mohan Ghosh, have also worked very zealously and usefully during the past year.

72. PUBLICATIONS. The publications issued by the Office during the past year are,—

1. Report on the Meteorology of India in 1876.
2. Part II of the Indian Meteorological Memoirs.
3. Part II of the "Indian Meteorologist's Vade Mecum."

The first of these comprises the condensed results of 109 stations, exclusive of 178 stations for which rainfall only is given, and includes 8 in Ceylon. The full registers of six stations,—Calcutta, Lucknow, Nagpur, Lahore, Bombay and Madras,—are also given. The second publication contains three papers, *viz.*,—

1. Storms in Bengal in 1876, with increased atmospheric pressure. By J. Eliot, Esq., M.A.
2. On the rainfall of Benares in relation to the prevailing winds. By S. A. Hill, Esq., B.SC.
3. On the diurnal variation of the barometer at Calcutta and Hazaribagh. By H. F. Blanford, Esq.

Mr. Blanford also drew up from all the accessible records a catalogue of the cyclones of the Bay of Bengal. This was communicated to the Asiatic Society's Journal.

73. LIBRARY. The library is in excellent condition, and, with the exception of a few periodical publications, nearly the whole of the addition to the Library during the past

year have been presentations or works received in exchange for the Office publications. The following list of books presented and purchased shows the additions made between the 1st April 1877 and the 31st March 1878.

Presentations to the Library from the 1st April 1877 to the 31st March 1878.

Place.	Donor.	Title of Work.
Adelaide ...	C. Todd, Esq., Director of the Observatory.	Meteorological observations made at the Adelaide Observatory, January to December 1876.
Ditto ...	A. Ringwood, Esq. ...	Means by which the height of clouds can be obtained by one Observer.
Amsterdam ...	Royal Academy of Sciences ...	Verslagen en mededeelingen afd Natuurkunde, Vols. X & XI. Jaarboek, 1875 and 1876. Proces Verbaal, 1875-76, 1876-77.
Bombay ...	F. Chambers	The diurnal variation of the wind and barometric pressures, by F. Chambers, Esq. Brief sketch of the Meteorology of the Bombay Presidency in 1876.
Ditto ...	Acting Superintendent, Colaba Observatory.	On the mathematical expression of observations of complex periodical phenomena, and on planetary influence on the earth's magnetism, by C. Chambers and F. Chambers. The absolute direction and intensity of the earth's magnetic force at Bombay, and its secular and annual variations, by C. Chambers.
Brussels ...	Observatoire Royal ...	Meteorological Observations, January to May 1877. Resumé des observations sur la Meteorologie et sur la Physique du globe, 1876. Title page for the volume of Meteorological observations for 1876. Observations at other stations, March to October 1877.
Budapest ...	Central Anstalt für Meteorologie und erd-magnetismus.	Jahrbucher, Bands IV & V, Jahrgang, 1874 and 1875.
Calcutta ...	Home Department, Government of India.	Report on the Treasury Commission. Report of the Meteorological Committee of the Royal Society for the period of seventeen months ending 31st May 1877.
Ditto ...	Government of India, Department of Revenue, Agriculture and Commerce.	Report on the condition of Meteorological Observations in the Berars, with suggestions for their improvement, by Mr. F. Chambers, Meteorological Reporter for Pombay, &c. General Report on the operations of the Great Trigonometrical Survey of India during 1875-76. Abstracts of the Reports of the Surveys and of other Geographical operations in India for 1874-75. The cycle of drought and famine in Southern India, by W. W. Hunter. 1877.
Ditto ...	Government of Bengal ...	Report on the International Trade of Bengal, 1876-77. Brief sketch of the Meteorology of the Bombay Presidency for 1876, by F. Chambers, Esq. Administration of Bengal, 1876-77. Statistical account of Bengal, by Dr. W. W. Hunter, Vols. VI —XIX.

Presentations to the Library from the 1st April 1877 to the 31st March 1878—continued.

Place.	Donor.	Title of Work.
Calcutta ...	Henry F. Blanford, Esq. ...	On the Physical Explanation of the Inequality of the two semidiurnal oscillations of the barometric pressure.
		Administration Report upon the proceedings of the Madras Observatory and Meteorological Department, 1875.
		Meteorology of India, Famine year 1876.
		Catalogue of the recorded cyclones in the Bay of Bengal up to the end of 1876.
Ditto ...	Colonel Walker, Surveyor General of India.	Great Trigonometrical Survey of India. Spirit-levelled height No. 2.
		Southern India. Preliminary results of the levelling operations of the Great Trigonometrical Survey of India, season 1873, 1874, 1875.
Ditto ...	Sanitary Commissioner, Government of India.	Thirteenth Annual Report for 1876.
		Report on the Cholera Epidemic, 1875-76.
Ditto ...	Ditto ditto, Bengal ...	Report of the Sanitary Commissioner, Bengal, for 1876.
Cambridge (J. S.) ...	Museum of Comparative Zoology at Harvard College.	Annual Report of the Trustees for 1875.
Canada ...	Meteorological Office, Toronto ...	Reports on the Meteorological, Magnetical, and other Observations in the Dominion of Canada for 1876.
Christiania ...	Royal University ...	Norske Meteorologisk Aarbog for 1871.
		Die Pflanzenwelt Norwegens.
		Études sur les mouvements de l'atmosphére, Part I.
		Windrosen des Lüdléchen Norwegens.
Copenhagen ...	Meteorologique du Nord ...	Bulletin of Meteorological Observations, February 1877, and April 1877 to January 1878.
Ditto ...	Danske Meteorologiske Institut ...	Le Fochu der Gromland.
Ditto ...	L' Institut Meteorologique Danois	Annuaire Meteorologique Pour l' Année 1875, part II.
		Meteorologisk Aarbog for 1876.
Ditto ...	Kong Danske Videnskabernes Selskabs.	Oversigt No. 2 of 1876 and No. 2 of 1877.
		Tyge brahes Meteorologiske dagbog.
Dehra-Dun ...	Colonel J. T. Walker ...	On observations of terrestrial refraction at certain stations situated on the plains of the Punjab.
		Notes on the Harmonic Analysis of tidal observation.
Ditto ...	Superintendent, Great Trigonometrical Survey of India.	General Report on the operations of the Great Trigonometrical Survey of India during 1876-77.
Edinburgh ...	R. Tennant, Esq., R.E. ...	Why the barometer does not always indicate real vertical pressure.
Ditto ...	Dr. W. W. Hunter ...	The cycle of drought and famine in Southern India.
Greenwich ...	Royal Observatory ...	Greenwich Magnetical and Meteorological observations, 1874 and 1875.
		Report on the Transit of Venus as seen at Lahore and Roorkee on 8th December 1874, by Colonel J. F. Tennant, R. E.

Presentations to the Library from the 1st April 1877 to the 31st March 1878—continued.

Place.	Donor.	Title of Work.
Hamburgh ...	Deutschee Sewartee ...	Monaltiche Ubersicht der Witterung, January to October 1876 and January to September 1877.
Henzada (Burmah) ...	R. Gordon, Esq., C.E. ...	The theory of the flow of water in open channels.
Hong-Kong ...	Government of Hong-Kong ...	Meteorological Observations taken at the Government Lock-Hospital, Hong-Kong, from February 1877 to January 1878.
		Report of the Treasury Commission.
		Meteorological Observations at stations of the second order, part II, 1875.
		Ditto ditto ditto, 1876.
		Daily Weather Report, from January to June 1876, July to December 1876, and January to June 1877.
		Quarterly Weather Report, parts III and IV, 1874.
		Ditto ditto, parts I, II, 1875.
London ...	Meteorological Office ...	Charts of Meteorological data for nine, 10° squares, Lat, 20° N. to 10° S., Long. 10° to 40° W.
		Remarks to accompany ditto.
		Supplement to the Report of the permanent Committee of the first International Congress at Vienna.
		Hourly readings of the seven observatories, &c., October 1876 to May 1877.
		Bulletin International de l' Observatoire de Paris, from April 1876 to December 1877.
		Report of the Meteorological Committee of the Royal Society for the period of seventeen months ending 31st May 1877.
Ditto ...	Meteorological Society ...	Quarterly Journal, new series, Vol. III, Nos. 21 to 24.
Ditto ...	Royal Asiatic Society ...	Journal, No. IX, parts I, II.
Ditto ...	Society of Arts ...	Journal Nos. 1266—1287, and 1289—1318.
Ditto ...	J. J. Hicks, Esq. ...	Hick's wholesale Catalogue of Meteorological and Scientific Instruments.
Ditto ...	India Office, Geographical Department.	Abstract of the reports of the Surveys and of other Geographical operations in India for 1874-75.
Ditto ...	The Publishers ...	The Colonies, Nos. CCXXXVI to CCLVII.
Ditto ...	Kew Committee of the Royal Society	Report of the Kew Committee for the year ending 31st October 1876.
		Ditto ditto ditto 31st October 1877.
Ditto ...	Royal Society ...	Proceedings, Nos. 176 to 183.
Ditto ...	The Editor ...	Symons' Monthly Meteorological Magazine, March 1877 to February 1878.
Lucknow ...	Dr. Bonavia, Scientific Officer, Oudh	Report on the Meteorology of Oudh, and of the working of the Horticultural Gardens, Lucknow, for the year 1876-77.
Madras ...	Government of Madras ...	Singapore Meteorological Observations, 1841-45.

Presentations to the Library from the 1st April 1877 to the 31st March 1878—continued.

Place.	Donor.	Title of Work.
Mauritius ...	Meteorological Society ...	Monthly Notices, 31st December 1876, new series, No. I.
Ditto ...	C. Meldrum, Esq. ...	Sunspots and rainfall.
Ditto ...	Professor William Blair ...	Causes of the Huron disaster.
		Meteorological method.
Melbourne ...	Observatory ...	Monthly records of observations, September 1876 to July 1877.
		Results of observations, &c., during 1875.
Mexico ...	Central Meteorological Observatory.	Registro Meteorologico del observatorio central del Placio Nacional de Mexico, March 1st to 15th April, 1st May to 15th June 1877.
		Mexico, Synoptic Observations, 1st May to 15th October 1877.
		Bulletin del Ministrio de fomento de la republica Mexicana. Nos. 1, 2, 4—9, 11—39, 41—58.
		Boletin, Tomo 1, Nos. 76—86.
Munich ...	Bavarian Academy of Sciences ...	Abhandlungen der Mathm. Physik., classe XII, 3.
New South Wales ...	John Tebbutt, Esq. ...	Results of Meteorological Observations made at the private observatory of John Tebbutt, Esq., for 1871—76.
New York ...	Central Park Observatory ...	Annual Report for 1876.
Oxford ...	Radcliffe Trustees ...	Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, 1858—73, and 1875.
Paris ...	Observatoire de Montsouris ...	Bulletin Mensuel January 1877, and March to November 1877.
		Annuare pour l'an 1878, Meteorology.
Ditto ...	Observatorie de Paris ...	Bulletin International, No. 75 of 1877.
Perth, Western Australia	Surveyor General ...	Meteorological Report for the year 1876.
Pesaro ...	Observatory ...	Sheets of Meteorological curves, December 1876 to August 1877.
Philadelphia ...	Franklin Institute ...	Journal Nos. 614 to 626.
Prag ...	K. K. Sternwarte ...	Astronomische, Magnetische, und Meteorologische beobachtungen, 1876.
Singapore ...	Principal Civil Medical Officer, Straits Settlements.	Singapore Meteorological Observations, January to December 1876.
		Register of rainfall at seven stations, 1876.
		Annual Abstract of Meteorological Observations, 1876.
		Comparative annual abstract of rainfall for 1869—76.
		Annual Report, 1876.
St. Petersburgh ...	Dr. A. Weikof ...	Die Monsune und das Klima Indiens.
Sydney ...	Government Observatory ...	Climate of New South Wales, descriptive, historical and tabular.
		Meteorological Observations from June 1876 to May 1877.
Tasmania ...	Royal Society ...	Papers and Proceedings and Report of the Royal Society of Tasmania for 1876.

Presentations to the Library from the 1st April 1877 to the 31st March 1878—continued

Place.	Donor.	Title of Work.
Turin ...	R. Osservatorio Astronomico di Torino.	Bollatino dell Osservatorio, Anno XI (1876). Effemeride del sole della Luna e die principali planeti per l' Anno 1878.
Upsala ...	L' Observatoire de L' Universite ...	Observations Meteorolgiques Horaires from 30th May 1865 to 9th August 1868.
Vienna ...	Dr. J. Hann ...	Zeitschrift der anst. Gesell. für Meteorologie, Nos. 6—24 1877, and 1—5, 1878.
Ditto ...	K. Akademie der Wissenschaften	*Durige*, die nichtpoleren discontinuilaten. *Farsky*, Bestimmungen der atmospharischen kohlensäure in den Johren, 1874-75 zu Tabor. *Güntner*, Die Benützung der Sonnenwärme. *Hopfgartner* and *Arzberger*, Ein Neues Tiefloth. *Jelinek*, Die constanten der Aneroide. *Lang*, Theorie der Droppelbrechung. *Pfaundler*, Differenzial-Luftthermometer. *Puschal*, Neue Satze der mechanischen Warmetheorie, I and II. *Rittinger*, Einige merkwürdige Erscheinungen. *Sternech*, Einfluss des mondes. *Subei*, Manometer-Hygrometer. *Weyprecht*, Hauptresullate. Mathm. Anzeiger, 1876, Nos. 1—19.
Ditto ...	K. K. Geologischen Reich Anstalt...	Verhandlungen, Nos. 11—17 of 1876, with title page. Ditto, Nos. 1—10, 1877.
Vizagapatam ...	A. V. Nursingrow, Esq. ...	Results of Meteorological Observations taken in 1876 at G. V. Juggarow's Observatory, Vizagaptam.
Washington, U. S. ...	Chief Signal Office ...	Daily Bulletin of the Signal Service U. S. A., with the synopses, probabilities, facts, February to December 1873, and January to March 1874. Bulletin of International Observations, 12th February to 23rd May 1877. Monthly Weather Review, August to December 1877.
Ditto ...	Dr. Emil Bessels, Chief of Scientific Department, U. S. Arctic Expedition.	Scientific results of U. S. Arctic Expedition, *S. S. Polaris*, C. F. Hall, Commanding, Vol. I.—Physical Observations.
Ditto ...	Naval Observatory ...	Washington Astronomical and Meteorological Observations, 1874.
Ditto ...	Smithsonian Institute ...	Smithsonian Report, 1875.
Ditto ...	U. S. Coast Survey ...	Meteorological Researches for the use of the Coast Pilot, Part I.
Wellington ...	Observatory ...	Abstract of Meteorological Observations, New Zealand, from August 1876 to July 1877.

Presentations to the Library from the 1st April 1877 to the 31st March 1878—concluded.

Place.	Donor.	Title of Work.
Wellington ...	Observatory ...	Meteorological Observation in New Zealand during 1876.
Zikawie ...	Magnetical and Meteorological Observatory.	Bulletin des Observations, September 1874 to December 1875, for 1876, and January to November 1877.
		Recherches sur les principaux phinomenes de Meteorologie et de physique terrestre a l' Observatoire Meteorologique et Magnetic de Zikawie Pres Changhai, China.

Purchases for the Library.

American Journal of Science, Vol. XIII, Nos. 74—78; Vol. XIV, Nos. 79—84.
Ditto ditto ditto for 1876.
Philosophical Magazine, Vol. 3, Nos. 17—23.
Ditto ditto for 1876.
Zeitschrift der Oesterreichische Gesellschaft für Meteorologie, 1877, Nos. 2—24.
Comptes Rendus de l' Academie des Sciences, vol. 74, Nos. 7—26, Vol. 75, Nos. 1—27, and Vol. 76, Nos. 1—4 and 6—8.
Annalen der Physik und Chemie, 1877, Nos. 2—12; 1878, No. 1.
Reports of the British Meteorological Society, from 1851—1854 and 1856—1861.
Report of the British Association, 1875, 1876.
Proceedings of the British Meteorological Society, Vols. IV, V.
Memoirs of the Literary and Philosophical Society, Manchester, Vols. 1—22.
Guyot's Smithsonian Meteorological and Physical Tables.
Chambers' Mathematical Tables.
Lockyer's Solar Physics.
Dixon's Treatise on Heat, part I.
Dalton's Meteorological Observations and Essays.
Webster's recurring atmospheric periods.
Inward's Weather lore.
Angus Smith, Air and Rain.
Ganot's Physics.
Dove, Meteorologische Untersuchungen.
Jelineck, Täglichen Gang der Vorzüglichsten Meteorologischen Elemente.
Poggendorff Biographisch Literarisches Hand worterlench, Vols. I and II.
Annuari de la Societe Meteorologique de France, 1849—1871.
The Bellary District Manual, compiled by J. Kelshall.
Rowell on the cause of rain.
Clements Ley. The laws of the winds prevailing in Western Europe.
Langhton's Physical Geography.
Mohn. Grundzuge der Meteorologie.
Ebermayer Die Physicalischen Einwirkungen des waldes, text I and plate I.
"Nature," Nos. 384—402, 404—436.
Hoffmeyer's Charts, July and August, 1875.
Tables des Comptes rendus, &c., tome LXXXIV.

APPENDIX A.

EXTRACT FROM MR. S. A. HILL'S REPORT.

INSPECTION OF OBSERVATORIES. Eight of the stations have been visited during the year, namely, Meerut, Chakráta, Sutna, Agra, Jhánsi, Lucknow, Gorakhpur and Benares. The first two were inspected in May, the third in October, and the others in December 1877.

At Meerut the observatory shed is in the Civil Surgeon's compound, where, owing to the proximity of the house and of some large trees, the exposure of the thermometers is not so good as might be desired. The shed is a large one of the Bengal pattern, but its eaves do not project far enough to protect the thermometers from the morning and evening sun. To remedy this defect, Dr. Moir had caused a piece of coarse matting to be stretched along the east and west sides, but at the time of my visit this appeared to have the effect of preventing the free circulation of the air. I therefore requested the Superintendent to get the lower half of the matting removed on each side, so as to leave a clear space three or four feet high all round. The thermometers I found to be all in good order, though most of them were very dirty but the barometer was a little out of the vertical. Up to the time of my visit this instrument had been kept in the thermometer shed, but while I was there I got it removed into Dr. Moir's office, where it is less exposed to sudden variations of temperature. The apparent increase in the daily range of the barometer at Meerut during the latter half of 1877 is due to this change of position. The rain-gauge was an old one of Fleming's pattern, the divisions on the measuring rod of which were almost obliterated. It has since been discontinued, and a new gauge on Symons' principle substituted for it. Neither a wind-vane, nor any substitute for one, was in use when I inspected the observatory, and the observer stated that for nine years he had been in the habit of guessing the direction of the wind without the use of any instrument. An ordinary vane was afterwards sent from Calcutta, and has, I believe, been erected on a post on the roof of Dr. Moir's house in a position similar to that of the anemometer.

At Chakráta I found that the repairs ordered by Mr. Blanford in December 1876 had been carried out under the superintendence of the Executive Engineer, and that the condition of the observatory was generally good. The shed had been in great part reconstructed, and a substantial wooden framework had been erected for mounting the wind-vane and the anemometer. The barometer I found exactly as it had been left by Mr. Blanford, and the observer seemed able to read it with quickness and accuracy. The thermometers were all in good order, except the wet minimum No. 8900, which had the spirit-column broken. This was rectified at the time, but the instrument afterwards frequently went out of order, and in August another, No. 8895, was sent to replace it. The rain-gauge at Chakráta was not quite level, but Mr. Bromley has since got it fixed securely in the ground with the mouth of the funnel horizontal.

At Sutna, where the observations have been carried on under the careful superintendence of Dr. Goldsmith, I found everything satisfactory.

The thermometer shed at Agra was thoroughly repaired after my visit in 1876, and most of the surrounding trees had either been cut down or had their lower branches removed before I saw it again in 1877. The condition of the shed was thus very satisfactory in every respect but one. To prevent stray cattle from entering and disturbing the instruments, a close-fitting bamboo *jaffry* (which did not appear in the least necessary) had been put up all round. Dr. Hilson, however, promised to have it removed and to erect a light paling round the shed at a considerable distance from it. The instruments in use at Agra I found to be all in good order.

The observatory shed at Jhánsi was completely rebuilt (at the expense of the North-Western Provinces Government) in April 1877. The new building is a substantial thatched shed, of an oval form, differing from those used in Bengal only in having light sandstone columns instead of bamboo posts. The stone pillars may be objected to on account of their absorbing power for solar heat, but they

are very slender; their original cost was little more than that of wooden posts would have been, and they are not liable to be destroyed every year by white ants. A more objectionable feature about the new shed is that its floor is made of "pucka" stone and lime, instead of simple earth, but the eaves descend so far as to shade it well. During the greater part of August and September this station was without a barometer, owing to the mercury leaking out of the instrument formerly employed. A new instrument was sent at the end of September, and this I found suspended in a bad position in the dispensary building to which the observatory is attached. I found the barometer somewhat out of the vertical, and put it right at the time, but Dr. O'Brien has since removed it to a better and more secure position which I pointed out to him in the same room. The other instruments at Jhánsi were all in good order except the rain-gauge, which was quite unserviceable. A new gauge was sent without delay to replace it.

At Lucknow everything was found in perfect order, with the exception of the Osler's anemometer and accompanying rain-gauge. A Beckley's self-registering anemograph has recently been received from Calcutta to be substituted for the Osler, and its traces have been taken since the 30th March.

The shed at Gorakhpur had been thoroughly repaired in June 1877, and when I reached that station in December I found it in a very satisfactory condition. All the thermometers appeared to be in good order, but the rain-gauge was in a bad position, between the shed on one side and a tree on the other. Since my visit it has been removed to an open space, forty yards distant from any higher object. An anemometer had been lying at this station for more than a year, but could not be used for want of some suitable position for exposure. The Superintendent was instructed to get it erected on one corner of the dispensary roof, and the North-Western Provinces Government has provided the cost of erecting a ladder or staircase to give access to it.

The last station visited was Benares, where I found that the observatory shed required re-thatching which, with other minor repairs, has since been done. The thermometers at this station were all in good order, and so, for anything I could see, was the barometer. This instrument had, however, for many months been reading persistently low, and it was therefore taken down to Calcutta in February by Mr. Blanford in order to be again compared with the standard. The result of this comparison shows that the abnormally low readings were not the fault of the instrument, but must have been due to the unusual meteorological conditions of the year which rendered Benares a centre of low pressure.

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Meteorological Office. The number of men employed in the office was the same as in the previous year. The reduction of the observations and the compilation of the monthly registers was carried on as usual. Copies of the registers were forwarded from time to time to the Central Office in Calcutta, and the last of these were despatched on the 14th March 1878. A monthly abstract of the observations, with a short discussion of the more important meteorological features of each month, has been published regularly in the *North-Western Provinces and Oudh Gazette*. Weekly reports of the rainfall recorded at the various police and tahsil stations in the provinces have also been regularly published, and these have been combined in an annual statement for the year 1877. The computers have all worked very well, but the amount of work to be done has been so great that the registers are now more than a month in arrear.

APPENDIX B.

EXTRACTS FROM Mr. F. CHAMBERS' REPORT.

* * * * * * * *

3. The Department is much indebted to the Maharajah of Bickanir for assistance in the establishment of the observatory at his capital. He was good enough to send his own bearers, accompanied by the native doctor, all the way to Sambhur for the meteorological instruments, all of which were conveyed thence safely over the 150 miles of rough country to Bickanir. I have not yet been able to visit this station, and the observatory has therefore been established by means of correspondence with Captain C. W.

Burton, the Political Agent, who has taken much pains in carrying out my instructions, and in generally supervising the native doctor who is in charge of the observatory.

4. INSPECTION OF STATIONS. My tours of inspection during the past year have been determined chiefly by the character of the registers received from the newly established stations, those from which the registers were least satisfactory having first been inspected.

5. *Surat.*—I visited this station in April 1877, and saw the instruments properly erected, and the registrations commenced.

6. *Rajkot.*—This station was inspected in October 1877. On arrival, I found the instruments had been properly erected, and that they were all in good order, particularly the wet bulb thermometers. The thermometric observations were being properly recorded, but the observer did not read the small divisions of the venier of his barometer quite correctly. The effect of this inaccuracy on the mean results is, however, but trifling. The wind, and general weather observations, made up to October, were found to be unsatisfactory, and they have been rejected. I compared the barometer with my standards, without removing it from its position, and found its error sensibly the same as that determined in the Bombay office.

7. *Poona and Sholapur.*—These stations were inspected in November and December. At Poona everything was found in proper order, and in the same condition as at my previous inspection in December 1875. The barometer was again compared with my standards, as on the previous occasion, and the same correction obtained, proving that no deterioration had taken place. The proposal to suppress this observatory and establish another in a more suitable site is now being carried out, arrangements having been made for a new observatory at the Yerrowda Jail in an exposed situation, which, on the whole, affords a better site than the Sassoon Hospital which was first contemplated.

8. At Sholapur the instruments generally were found in good order, except that the surface of the mercury in the barometer cistern had become much oxidized, thereby interfering with the setting of the zero point. Having compared the barometer with my standards, I cleaned the cistern, and then made another set of comparisons. From these it appears that the barometer was then in the same satisfactory condition as when despatched from Bombay. A comparative set of observations made with the observer, showed that his readings of the various instruments were very satisfactory. Some confusion was found to have arisen in the method of obtaining true local time, the result being that all the observations up to the time of my visit had been made half an hour late.

9. *Karwar and Ratnagiri.*—These stations were visited early in January. At Karwar a new observatory is being established under the Port Officer, who has volunteered to keep the Meteorological Register. I took with me a set of verified instruments for this station, selected the best sites for them, trained an observer, and compared the barometer with my standards. Satisfactory barometric and general weather observations have been received from this station since the 24th October 1877.

10. At Ratnagiri I found that the meteorological shed had been erected in the middle of the Civil Hospital compound. The thermometers themselves were found in good order, but the circulation of the air around them had been somewhat impeded by the manner in which the cage containing them had been fixed. This was pointed out to the Engineer, who promised to rectify the defect. I examined the observer, who is unusually intelligent, and found that he made all the more important observations very satisfactorily. I gave him what further instructions he required, and before leaving compared the barometer with my standards, and carefully cleaned away a scum that had formed on the surface of the mercury in the barometer cistern.

11. *Surat.*—At the end of March I again visited Surat to arrange for anemometric registrations to be made on the top of the clock-tower, and to inspect the observatory that has been established at the Native Regimental Hospital. I found most of the instruments in good order, but the wet bulb thermometers were not as clean as they ought to have been, and the bulb of one of them was dry from careless adjustment of the thread which conducts the water to the bulb.

12. METEOROLOGICAL ERECTIONS. Meteorological sheds of the standard pattern have been erected during the year at Rajkot, Malegaon, Indore, Neemuch and Bickanir, and others are now being erected at Satara and Karwar. Posts and other constructions for the anemometers and wind-vanes have been provided at Surat, Jacobabad, Hyderabad, Bickanir, Mount Abu, Sholapur and Satara; and others are now in course of erection at Deesa, Rajkot, Neemuch and Poona. Similar provision, at my suggestion, is also being made at Akola, Amraoti, Buldana and Chikulda by the Sanitary Commissioner, Hyderabad Assigned Districts.

13. A list of the observatories showing the names of the officers in charge and those of the observers is appended.

14. INSTRUMENTS AND THEIR VERIFICATION. The old instruments at the four Berar observatories and at Abu and Kurrachee have been recalled, and new ones that have all been verified in the Bombay Office have been supplied in their places. New sets of verified instruments have also been furnished to Poona, Belgaum and Deesa. New thermometer cages have also been furnished to all the above stations except Kurrachee. Other instruments to replace breakages (particularly of solar and nocturnal radiation thermometers) have been verified and despatched as required. Many of the sun maximum and shade maximum thermometers on Philip's principle have had to be renewed in consequence of their having become disordered by the disappearance of the air speck. Maximum thermometers on this principle are evidently less reliable in the hands of ordinary observers than the patent maximum thermometers by Negretti and Zambra. Two of the barometers, *viz.*, those first sent to Malegaum and Surat have become deranged during the year from the same cause that has been found so troublesome in Bengal, *viz.*, leakage of the mercury at the cisterns, and the barometer at Abu fell down and was broken owing to the faulty construction of its suspension piece. It is very desirable that all stations should eventually be furnished with standard barometers of the very best kind. These should be specially constructed for India. They should be provided with air traps and some special means of facilitating the removal, at frequent intervals, of the scum of oxide of mercury which in India forms so rapidly on the surface of the mercury in the cistern, and this contrivance should be such as will not necessitate the inversion of the instrument. It would be a great improvement, too, if the scales of the barometers that are placed in the hands of ordinary observers were divided to tenths of an inch merely, instead of to half-tenths, and if the verniers were enlarged to give all the sub-divisions of a tenth of an inch, instead of half-a-tenth only. It would then be practically impossible for an erroneous reading to escape detection, for its comparison with the corresponding readings from surrounding stations would be sure to reveal the error. Some satisfactory means of determining anemometer constants is also very urgently needed. I believe the future successful development of Indian Meteorology depends above all upon the efforts that are made to obtain thoroughly satisfactory observations of wind and barometric phenomena.

15. TRAINING OF OBSERVERS. An observer for the Makhla Forest Observatory in Berar has been taught how to register and reduce the various meteorological observations, and the construction and use of the various instruments have been explained to Mr. Drysdale, Deputy Conservator of Forests, who has charge of the Makhla Observatory. Also Hospital Assistant M. Cardoz, from Poona, has, at his own request, been taught how to keep a meteorological register. In order to prevent breaks in the continuity of the observations, owing to the temporary sickness or absence of the regular observers, the Surgeon General, Indian Medical Department, and the Surgeon General, British Forces, have, at my request, been good enough to cause all Hospital Assistants or Hospital Sergeants at the various hospitals where observatories are located, to be taught by the regular observers how to keep the meteorological registers, and it is hoped that this step will, in a great measure, prevent blanks from appearing in future registers.

16. METHODS OF OBSERVATION AND REDUCTION. The only change that has been made in the methods of observation consists in the substitution of Poëy's system of classification of clouds for that previously in use. At the second class observatories of Belgaum, Poona, Deesa and Kurrachee, the old series of observations at 9-30 A.M. and 3-30 P.M. were discontinued at the end of January 1878. Observations at 10 A.M. and 4 P.M., the hours chosen for general adoption in India, were commenced at these

stations in April 1876. The system of observation has been extended by the introduction, at the four second class observatories, of synchronic observations once daily at 7 hours 35 minutes A.M., Washington time. Another important extension was the commencement at the same stations in February 1878 of two more series of hourly observations per month, making in all three such series of observations monthly. I have also arranged at each observatory where an anemometer is erected, not only to have its reading recorded at the usual hours, 10 A.M. and 4 P.M., but also to have the *velocity* of the wind, as well as its direction, observed at those hours, and I intend, provided the computing force at my command will permit it, to have these observations resolved into their north and east components for comparison with the barometric and other phenomena. From this extension of the general system of observation I can already foresee that very valuable results will flow. From the beginning of September 1877, the observations taken at 10 A.M. at all the observatories have been reported daily direct to the Central Office in Calcutta.

17. * * * * * *

18. OFFICE ESTABLISHMENT. The office establishment has been increased during the year by one computer who was engaged in August 1877. I trust this additional help will enable me to keep all the current routine work of the office up to date, but I cannot hope with my present establishment to be able to do much more than this on account of the laborious nature of the regular routine operations. The salaries have, I regret to observe, proved too small to secure and retain the services of competent men, two of my most experienced clerks having withdrawn themselves from the office during the year to better their prospects elsewhere. A proposal was made during the year to dispense with the services of the soldier observers at the second class stations of Kurrachee, Deesa, Poona and Belgaum, but my urgent protest against this retrograde measure has, I am informed, prevented the step being taken.

19. WORK OF THE OFFICE. The observations of the year 1877 from twenty stations have been corrected and reduced and forwarded to Calcutta. Detailed statements of the rainfall at Kurrachee, Deesa, Poona and Belgaum for nineteen years have been compiled from the old registers and forwarded to the head office. New sets of instruments have been verified and despatched to Kurrachee, Deesa, Poona and Belgaum, Akola, Amraoti, Buldana, Chikulda, Karwar and Satara, and instruments to replace breakages have been verified and despatched to various other stations as required. The correspondence of the office has been nearly three times greater than in the previous year. It now presses very heavily on my time, unaided as I am by an experienced head-clerk.

20. At the request of the Bombay Government, I have supervised the provision and distribution of a new stock of Symon's rain-gauges, and have prepared a set of instructions and registration forms for the use of the officers in charge of the gauges.

21. With some extraneous assistance I also prepared a brief sketch of the Meteorology of the Bombay Presidency in 1876 for the Bombay Administration Report for 1876-77. In that paper I think I succeeded in showing that the abnormal meteorological conditions which produced the famine of 1877 were of the *same type* as those which produce the usual alterations of the seasons, and therefore are attributable to similar causes.

22. A commencement was made some time ago with the discussion of the Kurrachee wind observations, but the increasing demands of routine work which should be performed by an experienced head clerk has compelled me to lay it aside for a time, but I trust the provision shortly of a suitable head clerk will enable me to resume it. One of the most important results obtained is, that the numerical relation existing between the abnormal wind and abnormal barometric movements is exactly similar to the relation between the *annual* variations of the wind and barometer, leading to the same conclusion as above, *viz.*, that most of the abnormal variations of weather in India are due to causes which are similar to, if not indentical with, those which produce the normal variations. The comparison of the normal and abnormal barometric movements at different stations points decidedly in the same direction, and I believe that further investigation will prove this to be a general law affecting perhaps all abnormal meteorological variations which are not cyclonic.

23. The fact that a famine has been raging in China, at the same time that one has ravaged Southern India, does not appear to be without its significance in pointing to other than local causes of the meteorological disturbances which produce famines. Indeed, the inference that most of the unusual variations of weather in tropical climates are induced by corresponding variations in the *absolute* heating power of the sun, in the *same manner* that the seasonal variations are induced by those changes of heating power which depend on the relative *motions* of that body, seems almost irresistible, if it may not be regarded as already partly proved. The importance of this conclusion, if true, will be readily admitted, for it will be at once apparent, that if the absolute variations of the sun's heat are fitful in their occurrence, and do not obey definite periodical laws, it will perhaps never be possible to predict, by more than a few days in advance, the unseasonal variations of weather induced by them, while if such laws can only be discovered, the possibility of our being able to predict their consequences is equally certain.

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REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1878-79.

DURING the greater part of the past year, the charge of the Meteorological Department has been in the hands of Mr. J. Eliot, M.A., who was appointed to officiate as Meteorological Reporter to the Government of India during my absence on furlough. Under his direction, with two exceptions, the general work of the department has been carried on on the same system as in the previous year; the observatories, sanctioned in 1875, having been all established and in full work before the beginning of the year under report[1]. Of the exceptions referred to, one, and the more important, is the introduction, experimentally, of a system of daily telegraphic report of the 10 A.M. observations from about 50 stations; with a view to which, a special system of code telegraphy was elaborated by Mr. Eliot in conjunction with Mr. A. Pedler. This very important advance on the pre-existing system of daily postal report came into operation on the 15th June; and has been found so satisfactory, that it is now in contemplation to extend it to all observatories having telegraphic communication; and, furthermore, to supplement it by an extended system of report of the rainfall, from stations other than those provided with meteorological observatories. I shall recur to this subject later on in the report. The other exception is the transfer to the Meteorological Department of the duty hitherto performed by an officer of the Surveyor General's Department, of working the time-ball on the semaphore tower of Fort William. Arrangements for this purpose had been in great part made before the beginning of the year, by adding a transit room to the Alipore observatory, and in arranging for the necessary telegraphic communication. Also a new and improved form of time-ball apparatus had been sanctioned; and one of my duties, while in England, was to select a suitable form of apparatus, and, through the agency of the India Office, to order its construction. The new apparatus has not yet been received, and at the close of the year some final arrangements for removing the time-ball establishment from Chowringhee to Alipore were still in abeyance; but in anticipation of these, the charge of the work was taken over by Mr. Eliot in July 1878, and the time-ball operations have since been carried on by an officer of this department, from the old observatory on the roof of the Surveyor General's Office.

[1] With the exception of Mangalore in Madras, and Mandalay and Bhamo in Ava, which have, indeed, now been provided with instruments, but which, owing to political difficulties, have not yet begun to record observations.

An important incident of the year which deserves prominent notice, has been a tentative forecast of the character of the monsoon season, made by Mr. Eliot at the request of the Government in June last. The retardation of the monsoon rains in 1878, following on their almost complete failure in the North-Western Provinces in the previous year, was a cause of grave anxiety; and at this crisis, Mr. Eliot, having examined the existing meteorological statistics of previous years, which relate principally to Northern and Central India, submitted an opinion, based on the meteorological characteristics of the earlier months, to the effect that the advent of the rains would probably be retarded, but that, as there appeared to be no prominent irregularity in the distribution of pressure, it might be anticipated that they would be more equally distributed than in previous years. This prediction was borne out by the results.

This is not the first forecast that has been attempted in India. In July 1874 the late Mr. W. G. Willson was desired by the Government of India to furnish a similar opinion; and his forecast, based on far less data than are now available, and, relating only to the Presidency of Bengal, was, in like manner, justified by the result. But although these attempts have been successful as far as they go, I am of opinion that it is not advisable, in the present state of our knowledge, to undertake the regular publication of such forecasts, but rather to follow the example set before us in the case of storm warnings by the Meteorological Department of England, *viz.*, to frame them tentatively in the office, and to publish them only when an emergency may make such publication of unusual importance; until, in process of time, they may be issued with more confidence than is at present possible. That any such forecast is possible in India, is due to the fact first put forward in 1870, as an induction from the study of the Bengal registers, and verified in each succeeding year, *viz.*, that the distribution of atmospheric pressure is remarkably persistent in India in its abnormal as well as in its normal features; in the former, indeed, in certain cases, even more so than in the latter; and since the distribution of pressure is immediately related to the prevalent wind directions, and indeed in a great measure determines them, and the vapour supply is in its turn determined by the course of the winds, a knowledge of these relations, combined with that of the barometric features manifested in the beginning of the monsoon season, affords a certain criterion for judging the probable distribution of the rains.

With respect to Northern India, the normal distribution of pressure is now pretty well known; and were it not that the Madras registers[1] of all years prior to 1875 are still held back from publication, and even from communication to this office, by the Meteorological Office of Madras, that of Southern India might be almost equally so. But since such is the case, the meteorology of Madras, and in a great measure that of Bombay[2] also, are still imperfectly known; and the same may be said of British Burma, where a system of registration has been established only within the last three years. Every additional year will, however, increase our knowledge in the directions in which it is most deficient; and I think the date is not far distant when we may be able to frame forecasts of the seasons, with sufficient confidence to justify their publication.

One additional necessary datum or class of data, as was pointed out in the Bengal Administration Report for 1869, and again by Mr. Eliot in his Administration Report

[1] That is to say, all stations excepting Madras itself.

[2] Mr. C. Chambers' elaborate volume on the meteorology of Bombay has, in a measure, removed this objection, and the present deficiencies are owing to the fact that the Bombay stations which afforded his barometric data, or indeed any others of a quite trustworthy character (excepting perhaps in the case of rainfall), are too few for our requirements.

of last year, is a knowledge of the meteorology of the seas around India. This has been a subject of my attention from the time when a Meteorological Department was first established in Bengal; and an attempt was made, in 1869 and the subsequent years, to obtain observations, with this view, from the local shipping of the port. The steamers of the British India Steam Navigation Company, more especially the *Moulmein*, which, under Captain Ewart, used to run between Calcutta and Akyab, contributed some registers: but, partly owing to the absence of any proper establishment for verifying instruments and for working up the results, but chiefly to my own time being amply occupied by other work, so that I was unable to give to this department the time and attention indispensable for opening out a new field of observation, in which the contributors must be volunteers, the results were not successful to the object in view. At the present time, circumstances are much more favourable, and invite a renewal of the attempt. The Meteorological Reporter for Bengal is now relieved of the necessity of bringing together and working up the observations of other provinces in addition to his own; our knowledge of the land meteorology has made such strides that we are in a far better position than heretofore to appreciate the bearings of that of the sea and connect it with the variations of the former; we are now provided both with instruments suitable for marine observations and the means of verifying them; and Mr. Eliot is prepared, and has indeed proposed, to re-undertake the work, provided a small establishment is furnished for the purpose of reducing the observations. A proposal is now before Government having this object in view.

The work, sanctioned by the Secretary of State in 1875, of copying for the Indian Meteorological Office the ship observations relating to the Indian seas, that have accumulated in the Marine Department of the London Meteorological Office since its establishment by Admiral Fitzroy, is now nearly completed, and I expect to receive a large instalment of the work very shortly. The reduction and discussion of these data will be an undertaking requiring the assistance of a special establishment, and must necessarily occupy several months; but its importance is such, that I trust, notwithstanding the present financial pressure, that it may be found practicable to provide the indispensable assistance. When completed, this work will afford us a knowledge of the general meteorology of the adjacent seas, comparable to that which we now possess of the land; and we shall be able to appreciate the distribution and measure of the forces which set in movement the monsoons and determine their course and direction. The observations recorded by the Indian Meteorological Department have finally dissipated some of the long prevalent errors relating to the nature and course of the Indian monsoons; such, for example, as the belief, which may still be found perpetuated by a few writers of archaic ideas, that the summer monsoon of India is caused by the heat of Central Asia, and blows towards that region. But, with respect to the seas, we are still without any accurate knowledge of the origin of this summer wind: and whether the vapour which is discharged as rain over India and Burma is derived mainly from the seas to the south, or from those to the north of the equator; whether, in fact, the general body of the southern trade winds crosses the equator and feeds the monsoon, or, on the other hand, the North Indian Ocean is not the chief source of the vapour supply, and the connection of the monsoon with the southern trades only fortuitous and partial, are still more or less open questions. When the normal or average meteorological conditions of these sea-tracts are known, we shall be able to ascertain how far and in what

manner the variations that take place in different years affect the rainfall of India; and whether such great and disastrous droughts as that of 1876, for instance, are caused mainly by abnormal conditions pre-existing on the land region, or also in great measure by a deficiency of pressure over some part or parts of the ocean. These are only two of many problems which await their solution in the study of the meteorological marine logs.

The collection of the rainfall data of past years, with a view to a thorough investigation of the variations of the rainfall in different years, has been so far advanced during the past year, that the data are now sufficiently complete to warrant their final reduction and discussion. Indeed, some progress has already been made in this work; and a few of the preliminary results have been communicated to the Famine Commissioners, in a report which I was requested to draw up on my return to India in February last. The stations for which the registers have been tabulated, and the number of years to which they relate, are shown in abstract in Appendix G. The principal additions that have been made during the past year are the registers of stations in British Burma, Rajputana, Central India, Hyderabad, and Mysore; those of several Bombay stations for the years 1872-74; and those for a large number of stations situated in all parts of India for three or four years prior to 1856, which, as mentioned in my report for 1876-77, were in the hands of Baron Von Schlagintweit Sakünlunski; and to obtain copies of which, with the permission of the Secretary of State, I visited Munich in the latter part of last year.

The most important additions to the system of observation during the past year have been,—the experimental establishment of an observatory at Gilgit, which it is now proposed to make permanent,—and the extension of an accurate system of wind registration, by the erection of self-recording anemometers or anemographs at some of the second class stations. The stations to which these instruments have been furnished are—

Chittagong	Beckley's anemographs.
Saugor Island	
Rangoon	
Lucknow	
Roorkee	
Belgaum	
Deesa	
Patna	Casellà's anemographs.
Cuttack	
Hazaribagh	
Agra[1]	

Rangoon, Lucknow, and Cuttack have already contributed records. Similar instruments were previously in operation at Calcutta, Bombay, Madras, Dehra (North-Western Provinces), Mussooree, and Kurrachee.

The records of the Surveyor General's Office observatory have been transferred to this department. Among these are the traces of the Osler's anemograph and rain-gauge since June 1863, which may afford materials for useful discussion. They include also some other records of value.

A branch of physical enquiry, the close connection of which with meteorology has been fully recognized only within the last few years, is that of the physical condition of the sun. So long ago as the beginning of the present century, Sir William Herschell,

[1] Since the close of the year.

speculated on the probable variation of the sun's heat, and the consequences of such variation on terrestrial meteorology, and, secondarily, on agricultural produce. But it was not until the British Association meeting of 1872 that attention was prominently drawn to this subject by the late Colonel Strange; since which time, the study of solar physics has more and more been recognized as inseparable from that of the meteorology of our planet. Hitherto, such coincidences as have been traced out, with more or less distinctness or vagueness, between the variations of the sun's condition and the atmospheric and other physical phenomena of our planet and its inhabitants, have been purely empirical. To take, for instance, the case, which is perhaps the most firmly established of all, *viz.*, the variation of terrestrial magnetism,—all that can be said is, that the various changes in the sun's condition and position with reference to the earth, such as the diurnal and annual periods of the earth's revolution, the cyclical variation of sun-spots, the sun's periodical revolution on his axis, &c., are faithfully reflected in the variations of the terrestrial magnetism, in the varying intensity and direction of the force. But as to the chain of physical causes through which the solar variations thus re-act on the earth; whether, for instance, the influence is such as one magnet exerts on another, or whether the terrestrial magnetism is affected mediately, owing to a variation in the intensity of the solar radiation, are points on which various opinions are held.

The coincidences between solar and meteorological phenomena are less certainly determined; but, such as they are, they are of the same character, *viz.*, simple empirical coincidences, the physical reason of which is still obscure; and this obscurity cannot be removed until we have answered beyond all cavil the fundamental question, 'Does the intensity of solar radiation vary, *pari passu* with the visible changes of his surface, and, if so, what is the law of that variation?' The only attempts that have been made to answer this question, by direct observation, are two, *viz.*, a discussion by Mr. Baxendall of the recorded temperatures of sun thermometers at the Radcliffe observatory at Oxford, and at Eccles near Manchester; and a discussion of the recorded radiation temperatures at ten stations in different parts of India. In both cases the conclusion was the same, and distinctly indicated. The sun emits the more heat, the greater the visible agitation of the photosphere, as indicated by the greater number of spots, of red flames and faculæ. But the sun thermometer is justly regarded as an instrument inadequate to decide a question so important as that of the variations of the sun's heat; and, since it appears from other investigations that, in the tropics, at certain land stations, the temperature of the air follows an opposite course of variation (less distinctly indeed, and of smaller amplitude), some persons have drawn the conclusion that the variation of the solar heat is the opposite of that indicated by the sun thermometer. Others, again, have arrived at a similar inference, reasoning from the ascertained fact, that sun-spots emit less heat than the general solar surface; and forgetting, apparently, that sun-spots and faculæ increase and decrease together. The question, therefore, still remains for final decision; and there is no more important enquiry in the whole range of the science. Fully recognizing this fact, when lately in England, I consulted Mr. Norman Lockyer and Professor Balfour Stewart on the best means of aiding this enquiry in India, and on their recommendation I applied to the Secretary of State for sanction to the construction of a new form of actinometer, invented by Professor Balfour Stewart, the manufacture of which he very kindly offered to superintend. This was sanctioned, and the instrument may be expected shortly. Should experiments prove that it is well fitted for absolute measurements of the solar heat, and

such as can be employed effectively by the observers at the higher classes of observatories, it will then become a question whether three or four of the principal observatories should not be provided with them for regular observation.

There are probably other directions in which this important enquiry may be pursued. A committee, of which General R. Strachey is a member, is now sitting in London, to consider the best means of investigating the whole question of solar physics; and I have lately been informed that the Astronomer Royal, who is also a member of the committee, considers that the regular observation of earth temperatures by means of buried thermometers, somewhat similar to those employed by Professor Piazzi Smyth at Edinburgh, will be of much service to this end. There may be some practical difficulties in carrying out this suggestion in India; but only such as may be overcome with care and patience, and the subject will receive due consideration.

In the course of a tour on the Continent, which I made last year, I availed myself of the permission very kindly accorded by Mr. Janssen, the Director of the Physical Observatory at Meudon, to study and practice the process of solar photography which has been elaborated by him, and by means of which he then obtained pictures of the solar surface 30 cm. in diameter, in which the details of the solar structure are exhibited with a degree of definition and delicacy never previously attained. I learn from a recent notice in *Nature* that the size of these pictures is now increased to 50 cm., and that the interval between the recording of two such pictures in succession is reduced to two minutes. In London, also, Mr. Lockyer is active in the same direction; and, as I learn from a recent letter, expects in the course of a few weeks to be taking pictures of 14 ins. diameter. But the atmosphere and climate of London, and more or less of all parts of England, are very unfavourable for work of this kind; and it is proposed that, when the instrument is perfect, it shall be transmitted to India; when the work carried on, until lately, by Mr. Meins, at Roorkee, under the direction of the Surveyor General's Department, and which has been interrupted by the much-regretted death of this trained photographer, may be resumed in a much improved and extended form.

OBSERVATORIES.

Including private observatories and those carried on by volunteers and by Government officers independently of the Meteorological Department, there were, at the close of 1878, 105 observatories of all classes in British territory under the Government of India, and 5 in frontier and other foreign states, *viz.*:—

INDIAN.	
Bengal	19
North-Western Provinces	14
Punjab	11
Central Provinces	11
Berar	5
Central India and Rajputana Agencies	7
Bombay	15
Madras, Mysore, and Hyderabad	13
British Burma	8
Bay Islands	2
TOTAL ..	105

EXTRA INDIAN.

Goa	1
Cashmir territories	2
Balúchistan	1
Persian Gulf	1
TOTAL ...	5

This is an increase of 6 observatories on the number reported for last year. Of the whole, 2 are first class observatories, furnished with autographic instruments; 22 second class observatories, at 20 of which, in addition to observations daily at 10 A.M. and 4 P.M., and synoptic observations at 7 h. 45 m., Washington time, observations are registered hourly on four (or in some cases three) days on each month; and the remainder, with one exception, third class stations, registering two full sets of observations (in some cases three sets) daily. They may be further classified as—

Government observatories with paid observers under the Meteorological Department	94
Observatories at Government offices not under the Meteorological Department	14
Private and foreign observatories	2

OBSERVATORIES IN BENGAL AND ASSAM.—*The Calcutta Observatory.*—This observatory is under the immediate superintendence of the Meteorological Reporter to the Government of India. The work has been carried on during the past year as described in Mr. Eliot's Report for 1877-78. The autographic instruments are the barograph and thermograph, which record the atmospheric pressure and the temperatures of the dry and wet bulbs by photography; and the anemograph and hyetograph, which register the movement and direction of the wind and the rainfall. The two latter instruments work in a quite satisfactory manner, and their traces are regularly reduced and tabulated. The error of the hyetograph has been determined by the volumetric measurement of the rain-water collected during the last rainy season, and a comparison of this with the quantity shown by the traces; from which data, the factor 0·973 has been deduced for the correction of the latter. The friction error of the anemograph is not known. It was my desire to ascertain this by experiment in the Mathematical Instrument Workshop, before the instrument was set up; but the requisite facilities could not be provided for the purpose. The error, however, cannot be large.

The traces of the barograph and thermograph are not at present used for deducing the pressure and temperature for publication. The Kew photographic process, which affords excellent results so long as the temperature does not exceed 80°, fails, owing to fogging, at higher temperatures; and the traces obtained during the hottest weather are, from this cause, almost undecipherable. I have lately, at Captain Waterhouse's suggestion, tried the use of citric acid, and also the ferrous oxalate process of development, and both these produced a considerable improvement, since the traces, though not free from fogging, were quite distinct and measurable. The experiments were interrupted on my transferring my office to Simla, but I shall resume them next hot season, and I am not without hopes of eventually overcoming the existing difficulties.

Partly owing to these difficulties of the process and partly to other causes, the scale values of these instruments have not yet been fully determined. The thermograph was

sent out originally without standard thermometers having bulbs of the same size as those of the registering thermometers. In order, therefore, to obtain values for the traces, two thermometers with large spherical bulbs were placed side by side with the thermograph bulbs, and read at every even hour during the daytime; the one being read as a dry, the other as a wet bulb. It was speedily found, however, that owing to the difference in the form and volume of the standard and thermograph bulbs, the temperatures were not accordant. In the case of the dry bulbs, the variations did not exceed a few tenths of a degree, in either direction from the mean values; but in that of the wet bulb, the discordance was too great to allow of any trustworthy determination by comparison of the readings. The instruments having been set up in March 1876, it was necessary to wait nearly a whole year to obtain a comparison through the whole range of temperature. It was not, however, till the early part of 1878, that a sufficient number of traces had been obtained. These were then measured, and the whole of the readings recorded during the year were used in the determination of the scale values of the dry bulb. During my absence in England, the work remained in abeyance; but it was resumed on my return, and a scale has now been engraved in the Mathematical Instrument Workshops, by which the dry bulb traces can be measured. To obtain those of the wet bulb, I have now stripped the muslin from the latter, and the two thermometers are both recording as dry bulbs. After the lowest temperatures of the year shall have been obtained in January next, both sets of traces will be measured, and we shall be furnished with accurate values for the instrument.

The barograph has presented difficulties of another kind. The trace represents two variable values; one being the height of the barometric column, as affected both by temperature and pressure, above a constant zero; the other the variation of the temperature of the instrument, which is given by an independent apparatus carrying a moveable screen. The values of both of these have to be determined independently; and the latter should be so adjusted as to compensate the mean expansion of the mercurial column arising from temperature alone. The comparison of the barometer trace was made with the readings of the standard barometer, reduced for temperature and then corrected for the temperature of the barograph as given by the readings of its own thermometer. A year's observations sufficed to give the scale value of this part of the trace, but it was found that the range of the temperature screen was little more than half the proper amount. The thermometer compensation screen was then re-adjusted; but during my absence at Simla in 1877, the assistant unfortunately deranged the adjustment of all the screens, and in replacing the apparatus a portion of it was broken. After the repair, all the previous values being useless, except as regarded the range of the barograph trace, another year's traces were obtained, and a further re-adjustment was made. The adjustment is, however, not yet accurate, and it will be necessary to wait for another cold season to complete the setting of the instrument. The barograph trace may, however, be used independently, by applying a correction to the measurements, and it is useful for showing those variations of pressure that are only to be detected by a continuous record.

No change has been made in the regular observational work of the observatory during the past year. The regular hours for reading the barometer and thermometers for air temperatures are 6h. and 10h. A.M., and 4h. and 10h. P.M; and a set of readings is also recorded at 6h. 36m. P.M. as part of the system of synoptic observations, recorded in

different parts of the world, at the Washington hour of 7h. 35m. A.M. This system is under the superintendence of General Albert Myer, of the U. S. Signal Service. The wind directions and velocity are taken from the Beckley's anemograms. The rainfall from a Symon's gauge in the compound of the observatory: and the hours of rainfall from the Beckley's hyetogram. The latter being erected on the summit of one of the turrets of the building, 50 feet above the ground, shows a smaller amount of rainfall than that collected by the lower gauge.

The sun thermometer is exposed on a stand, 4 feet above the ground, on a well-grassed part of the compound, and 82 feet distant from the north face of the building. It is read at 4 P.M.

Three nocturnal radiation thermometers are used; one in the focus of a parabolic reflector turned to the zenith, the bulb being 6 inches above the ground; one on a pad of blanket, 12 inches square, which rests on the ground; and one on the grass. These are read at sunrise. They are 125 feet distant from the building.

Other observations are those of ground temperature, and of comparative air temperatures at different elevations. For the former purpose, three thermometers are used. One, a mercurial thermometer, is laid on the ground, the bulb being just covered with soil. A second, having a long stem, is inserted in the ground with the bulb 1 foot below the surface. The third, a mercurial standard thermometer, is inserted in a square staff 3 feet 6 inches long, the bulb at the lower end being protected by a copper cap. A wooden pipe of the same length as the staff has been inserted to the depth of 3 feet in the ground, and the staff and thermometer are introduced so that the copper cap rests on the ground. The tube is closed by a zinc cover to prevent the entrance of rain. Thus readings are obtained, showing the temperatures—of the ground surface,—at 1 foot deep,—and at 3 feet deep. The thermometers are read three times daily, *viz.*, at 5h. 45m. A.M., 1h. 45m., and 9h. 45m. P.M., *i. e.*, at intervals of 8 hours.

Readings of two sets of protected thermometers and hygrometers, at elevations respectively of 4 feet and 40 feet above the ground, under otherwise precisely similar conditions of exposure, are recorded at the same hours as the above.

The other work of the observatory consists of, *1st*, the comparison of all barometers issued to Indian observatories with the old standard of the observatory: *2nd*, the verification of the freezing points (of all excepting solar radiation thermometers) by immersion in crushed melting ice; and the verification of the same instruments at higher temperatures, by comparison in water with a Kew standard. It was found by a recent verification of the freezing point of this standard, that since it was received in 1867 (when its error was 0°), the freezing point has risen 0·4°, an error which therefore affects the whole scale of the instrument, and for which allowance is now made in verifying other instruments. At the same time, the freezing point of the old Calcutta standard thermometer[1] and the wet-bulb thermometer used with it during upwards of 20 years, were verified; with the result that the freezing point of the former is now 32·6° and that of the latter 32·5°: *3rd*, the comparison of the solar radiation thermometers for all observatories, except those of Madras, with an arbitrary standard instrument. This

[1] As the temperatures recorded with this instrument at the Surveyor General's Office have had no correction applied to the readings, it follows that, for many years past, corrections of the corresponding amounts must be applied to the registers; but it is of course impossible to say what part of the error affected the instruments in the earlier years.

is done by exposing all the instruments under comparison, on stands 4 feet high, set up at intervals of about 3 feet, on a grassy part of the compound, and taking from 30 to 40 readings of the temperatures recorded on as many consecutive days, in fine weather, together with those of a standard instrument. The mean difference of the readings thus determined is thenceforth applied as a correction to all readings of the compared instrument. The number of instruments verified, also those received and issued by the observatory, during the past year, are given in the foot note below[1].

Two new instruments have been set up at the observatory during the past year. One of these is the Osler's anemograph and rain-gauge, which (since June 1863) has been in operation on the top of the Surveyor General's Office in Chowringhee. The instrument records the direction and pressure of the wind, as well as the rainfall. In the second of these particulars, it furnishes a datum very important to engineers, but less useful for physical enquiries than the actual distance travelled by the wind, which is recorded by the Beckley. In the last particular, it furnishes a duplicate record of that given by the independent hyetograph already noticed. This instrument has been erected on the north-east turret of the observatory, the Beckley's anemograph being on the north-west turret. Before being brought into use, Mr. Pedler, then officiating as Meteorological Reporter to the Government of Bengal, tested the springs of the pressure plate, and found that their resisting force was less than that for which the forms hitherto in use were adapted, and he infers consequently that the wind pressures of recent years recorded at the Surveyor General's Office are somewhat excessive. New

[1] Instruments verified at the Alipore observatory during the year ending 31st March 1879—

Barometers	29
Dry and wet-bulb thermometers	19
Maximum thermometers	4
Minimum ditto	35
Nocturnal radiation ditto	24
Solar ditto ditto	25
Standard thermometers	10
Boiling point ditto	2
Sling ditto	1
Casella's anemographs	3
Osler's ditto	1
TOTAL	153

Instruments received at the Alipore observatory and issued during the same year—

	Received.	Issued.
Barometers	57	39
Dry and wet-bulb thermometers	24	15
Maximum thermometers for air temperatures	18	0
Minimum ditto ditto	7	39
Nocturnal radiation ditto	1	42
Solar radiation ditto	6	49
Standard thermometers	23	4
Boiling point ditto	2	2
Anemographs	7	1
Anemometers	18	3
Anemoscopes	19	0
Rain-gauges	0	22
TOTAL	182	216

forms adjusted to the pressures found by experiment have been prepared, and these are now in use.

The other instrument is the large standard barometer constructed for the observatory by Messrs. Casella & Co., and provided with a cathetometer of an improved construction. The instrument arrived in excellent condition, and has been set up in the instrument room of the observatory. Some experimental readings taken with it show a defect in the stability of the cathetometer telescope, which at present renders the readings uncertain, and my departure for Simla has prevented my taking the steps to have this remedied. In other respects the instrument appears to be all that can be desired.

The new transit room at the Alipore observatory was not made over by the Public Works Department until September 1878; and the setting up of the transit instrument was deferred until my return in February last. The long delay in the completion of the building appears to have arisen mainly from the faulty construction of the shutters. I had recommended, in the autumn of 1877, that the shutters which had been constructed by Colonel Tennant for the Roorkee observatory, and which, since the dismantling of that observatory, had been stored in the Roorkee Workshops, should be procured for the Alipore building. This, however, was not done, and the shutters at first constructed at Alipore proved unworkable. They were replaced after considerable delay; but on my return to India, I found that, not only were the fastenings of the roof shutters so badly fitted that the vigorous use of a mallet was necessary to open them, but that an open space beneath them would have allowed free access to wind and rain, to the great detriment of the instruments in the transit room. Moreover, wooden bars, forming a portion of a frame for the vertical shutters, crossed the meridian opening on both sides at a vertical angle of 45°, entirely obscuring the sun or any star at that altitude. When I left for Simla, these defects were in process of correction under the Executive Engineer who has succeeded the officer who erected the building, and a stone pillar was also being made for the collimating telescope. The position of the observatory renders it impossible to fix a meridian mark at a greater distance than the south margin of the Alipore parade ground, distant about a quarter of a mile; but this I propose to have set up when I return to Calcutta, and the clear skies of the cold weather admit of star observations being made for the final adjustment of the transit instrument. Till then, it will be necessary to continue the present arrangement, carried on, with the permission of General Walker, at the Surveyor General's Office.

The staff of the observatory consists of—

Babu Haran Chunder Mookerjee[1], M.A., Chief Observer.
" Khettra Mohun Mookerjee, 1st Photographic Assistant.
" Mahendra Nath Bhattacharjee, 2nd ditto ditto.
" Mohendra Nath Banerjee, Observer and Time-ball Assistant.
" Syam Lal Sen, ditto.

Babu Haran Chunder Mookerjee was appointed in July 1878, when the charge of the time-ball operations were taken over by this office, on the retirement of Babu Gopinath Sen. His work being carried on at the Surveyor General's Office, two miles distant from the Alipore observatory, the meteorological observatory has practically been deprived both of his services and those of Babu Mahendra Nath Banerjee, the assistant. They

[1] I much regret to announce that since the above was written I have heard of the death of this able officer, after an illness of three months.

have had, in addition to the time-ball work, the charge of the chronometers for rating, and that of the observations (at 10 A.M. and 4 P.M.) which have been continued at the Surveyor General's Office during the past year, for the purpose of obtaining a comparison between the temperatures, &c., recorded at the new and old observatories. Nevertheless, their work has been very light, and their absence has very much weakened the observatory staff, which is at present able to perform little more than to keep up the most essential parts of the current work. Meanwhile, the observatory has practically been in the charge of Babu Khettra Mohun Mookerjee, who resides in the building, and whose assiduous and careful performance of his duties I have much satisfaction in noticing.

The observations of temperature, &c., at the Surveyor General's Office, Chowringhee, above referred to, for the purpose of ascertaining the differences of mean temperature and temperature range at the new and old observatories, have now been carried on for two complete years; and, as the thermometer shed in the compound of the Surveyor General's Office has now been fallen into disrepair, they have been discontinued.

The results of the past year's observations of temperature are shown in the following table, similar in form to that in which the results of 1877-78 were given in Mr. Eliot's Report of last year:—

	Mean of Maxima.			Mean of Minima.			Mean Temperatures.		
	S. G. O.	Alipore.	Difference.	S. G. O.	Alipore.	Difference.	S. G. O.	Alipore.	Difference.
April 1878 ...	94·2	93·9	−0·3	78·2	75·6	−2·4	84·7	82·2	−2·5
May ,, ...	92·3	92·1	−0·2	77·1	74·5	−2·6	82·9	80·6	−2·3
June ,, ...	95·3	94·6	−0·7	82·9	80·7	−2·2	87·9	85·7	−2·2
July ,, ...	89·8	89·7	−0·1	81·1	79·6	−1·5	83·9	82·6	−1·3
August ,, ...	88·5	87·6	−0·9	80·5	78·9	−1·6	82·8	81·9	−0·9
September ,, ...	89·2	88·3	−0·9	80·5	79·0	−1·5	83·0	81·9	−1·1
October ,, ...	88·8	87·8	−1·0	78·4	76·1	−2·3	82·5	80·3	−2·2
November ,, ...	84·0	82·4	−1·6	70·8	68·0	−2·8	76·0	74·0	−2·0
December ,, ...	77·2	76·5	−0·7	61·7	58·4	−3·3	68·2	65·7	−2·5
January 1879 ...	79·1	77·5	−1·6	59·2	54·9	−4·3	68·2	65·0	−3·2
February ,, ...	85·3	84·0	−1·3	66·5	61·9	−4·6	74·6	71·7	−2·9
March ,, ...	94·1	92·6	−1·5	74·2	70·5	−3·7	82·5	79·1	−3·4

The mean results of the two years are as follows:—

Chowringhee minus Alipore temperatures.

	Difference of mean maxima.			Difference of mean minima.			Difference of mean temperatures.		
	1877-78.	1878-79.	Mean.	1877-78.	1878-79.	Mean.	1877-78.	1878-79.	Mean.
April 1878 ...	+0·4	−0·3	+0·05	−3·2	−2·6	−2·9	−2·8	−2·5	−2·65
May ,, ...	+1·2	−0·2	+0·5	−2·5	−2·6	−2·55	−3·1	−2·3	−2·7
June ,, ...	+0·2	−0·7	−0·25	−2·4	−2·2	−2·3	−2·8	−2·2	−2·5
July ,, ...	0	−0·1	−0·05	−2·1	−1·5	−1·9	−1·4	−1·3	−1·35
August ,, ...	+0·5	−0·9	−0·2	−1·6	−1·6	−1·6	−1·2	−0·9	−1·05
September ,, ...	−0·3	−0·9	−0·6	−2·2	−1·5	−1·85	−1·5	−1·1	−1·3
October ,, ...	−0·3	−1·0	−0·75	−3·1	−2·3	−2·7	−2·8	−2·2	−2·5
November ,, ...	−0·5	−1·6	−1·05	−5·0	−2·8	−3·9	−3·1	−2·0	−2·55
December ,, ...	+0·1	−0·7	−0·3	−5·0	−3·3	−4·15	−2·7	−2·5	−2·6
January 1879 ...	+0·8	−1·6	−0·4	−4·5	−4·3	−4·4	−2·4	−3·2	−2·8
February ,, ...	−0·4	−1·3	−0·85	−4·6	−4·6	−4·6	−2·7	−2·9	−2·8
March ,, ...	+0·1	−1·5	−0·7	−3·4	−3·7	−3·35	−2·5	−3·4	−2·95
Year	+0·15	−0·9	−0·38	−3·3	−2·75	−3·02	−2·42	−2·21	−2·31

From these it appears that the mean temperature recorded at the Alipore observatory, situated in a suburb with few buildings, each of which is surrounded by a large garden or park, is about 2·3° lower than that registered at the Surveyor General's Office, surrounded by lofty buildings, having small gardens or yards. The means of the maxima temperatures at the two sites, differ by less than half a degree on the average of the year; though varying greatly in different months; but the range of temperature is greater at Alipore, and the mean of the minima temperatures is more than 3° lower at the latter. As might be anticipated, the divergence is greatest in those months in which fine clear weather prevails, when the minimum temperature at Alipore is sometimes as much as 5·0 lower than at Chowringhee, on the mean of a whole month.

Other Observatories in Bengal and Assam.—Mr. Eliot's Report on the administration of the Meteorological Department in these Provinces, hereto appended, shows that there are now in operation seven observatories of the second class (five in Bengal and two in Assam), ten of the third[1], and one of the fourth class. At the first (except Saugor Island) observations are recorded daily at 10 A.M. and 4 P.M., and also at the local hour corresponding to 7h. 35m. A.M., Washington mean time; and, on the 7th, 14th, 21st, and 28th of each month, hourly, from midnight to midnight. At the third class stations, only two sets of observations are recorded daily, and at the fourth class the same, but the observations are restricted to the temperature, wind direction, and rainfall.

Second Class.

Sibsagar.	Patna.
Hazaribagh.	Saugor Island.
Goalpara.	Cuttack.
Chittagong.	

Third Class.

Darjeeling.	Durbhanga.
Gya.	Burdwan.
Jessore.	Silchar.
Purneah.	Dacca.
Berhampore.	False Point.

Fourth Class.

Demagiri.

Mr. Eliot reports that, with the exception of Goalpara, all the second class stations have been working well. At Goalpara the instruments were stolen, and suspicion was directed to the assistant observer, between whom and the chief observer there had been some bad feeling. This caused a *hiatus* of nearly seven weeks in the observations. Since this occurrence, the work has been carried on satisfactorily. The observatory at Chittagong has unavoidably been removed to a new site, but care has been taken to make the future observations as far as possible comparable with those previously recorded. It has also lately been found necessary to move the instruments at Hazaribagh; but, in this case, the distance between the former and present positions is but small, and the site is practically the same. Beckley's anemographs have been furnished to Chittagong and Saugor Island, and are now being set up; and two Casella's anemographs to Cuttack and Hazaribagh. The former is now at work.

The majority of the third class stations are also reported to be in satisfactory working order; Burdwan, Dacca, and False Point being by far the most so. The

[1] One included in Mr. Eliot's list is in Arakan, but under the Bengal Office.

observers at the two latter of these are the Electric Telegraph Masters, Mr. E. W. Shave and Mr. H. W. Alley. At Burdwan, the observer is Babu Mokodaprosad Chowdhry, who works under the superintendence of the Civil Surgeon. The Electric Telegraph Master at Akyab has on several occasions delayed the transmission of the precedence telegrams for 6 or 7 hours, and the Gya and Durbhanga returns show occasional discrepancies, which indicate carelessness on the part of the observers.

Four of the Bengal observatories have been inspected during the year,—Dacca and Silchar by Mr. Pedlar, and Jessore and Hazaribagh by Mr. Eliot. Silchar was found to be in a bad condition. This station has always given much trouble, and owing to its distance cannot be so frequently inspected as is desirable. Mr. Eliot reports, however, favourably of the observer. The condition of the observatory is described in Mr. Eliot's report. At Dacca, the instruments, except the anemometer, were generally in good order; but the position of the wind vane is not satisfactory. At Jessore, the observatory and instruments were in good order, but the exposure is not such as might be desired. The observer was found to be unpunctual in his observations. The Hazaribagh observatory was found to be in excellent order, and the observer, Raheem Oollah, is one of the most useful and trustworthy in Bengal.

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES.—In the North-Western Provinces and Oudh are ten observatories under the Meteorological Department, and three under independent management. Mr. Hill also supervises the observatories of Ajmere in Rajputana and Sutna in Baghelkand. Of the independent observatories, one, *viz.*, St. Fidelis's School, Mussooree, communicates its registers direct to Calcutta. In the hot weather and rains, a fourth independent observatory is established at the Great Trigonometrical Survey Office at Mussooree. There are thus, in all, fourteen observatories, to represent the meteorology of the Gangetic plain and the hills on its northern border, and also a portion of the elevated plain to the south. Of these, four are second class stations, or working as such; the remaining ten, third class stations, as follows:—

Second Class.	
Allahabad.	Agra.
Lucknow.	Roorkee.
Third Class.	
Benares.	Jhansi.
Ranikhet.	Bareilly.
Meerut.	Chakrata.
Gorakhpur.	Mussooree (St. Fidelis).
Dehra.	Mussooree (Great Trigonometrical Survey Office).

These two observatories at Mussooree are situated, one about half-way up the hill side, or rather on the summit of a projecting knoll, the other on the crest of the ridge; and afford, therefore, a pair of stations, differing only in elevation, from the registers of which some most valuable information may be deduced, respecting the vertical distribution of temperature, &c.; while a third station, only 7 miles from the foot of the hills, Dehra, completes this important series. The observations at St. Fidelis's School are carried on by the masters of the school, under the kindly volunteered superintendence of the Principal, Father Genesius, S.J., the instruments being furnished by the Meteorological Office; those at Great Trigonometrical Survey Offices at Dehra and Mussooree, by the officers of the Great Trigonometrical Survey. The Meerut observatory is at the charge of the Municipality.

At the Allahabad observatory alone, readings are recorded at 10 P.M. and 4 A.M., and synoptic observations at 6h. 10m. P.M., in addition to the two day observations, and to the regular series of hourly observations recorded on four days in each month. The situation of the observatory at the private dwelling of the Meteorological Reporter is by no means a good one; and its removal to the proposed site in the Alfred Park, *viz.*, at the Thornhill Memorial, is much to be desired. This will be effected as soon as the meteorograph arrives, which has been ordered for Allahabad. I saw the parts of this instrument at the maker's, Mr. Schubert of Ghent, in October last, and was entirely satisfied with the excellence of the work. The separate parts were then made and fitted, and only required finishing, and Mr. Schubert promised to have the instrument ready by the end of the year; but I am sorry to say that the last bi-monthly report received from the India Store Department still speaks of the date of its despatch as uncertain.

A Beckley's anemograph has been furnished to Lucknow and set up, but owing to various mistakes and the little difficulties attendant on the working of a novel instrument, no good results were obtained from it before the middle of January. A Beckley's anemometer has also been sent to Roorkee, and a Casella's anemograph to Agra, but neither has yet been fixed in position. Besides two observatories in Baghelkhand and Rajputana, Mr. Hill has inspected five of the North-Western Provinces observatories during the year, *viz.*, Lucknow, Bareilly, Ranikhet, Agra, and Benares. At all these latter stations he found the condition of the observatory buildings and that of most of the instruments satisfactory. The details are given in his report, in the Appendix B. I. He finds that, on the whole, the character of the observatories has improved during the year. "The stations from which good returns were received in previous years have maintained their character, while the others have improved, until all the observations now appear to be taken with equal care and exactness. The only register to which the suspicion of dishonesty sometimes attaches is that of the hourly observations at Roorkee. The doubtful figures are those recorded in the early morning hours, when it is to be feared the observer sometimes goes to sleep." I drew a similar conclusion myself some time since from these observations. It is, however, but justice to add that the Superintendent, Dr. Murray Thomson, considers this opinion unjustified. The names of the Superintendents and Observers of the several observatories in the North-Western Provinces will be found in the Appendix B. II.

OBSERVATORIES IN THE PUNJAB.—The observatories in the Punjab, with the exception of Lahore, all work as third class stations. Lahore alone is carried on as an observatory of the second class, pending the arrival of the self-recording instruments. The following are the stations reporting during the past year:—

Second Class.

Lahore.

Third Class.

Peshawar.	Dera Ismail Khan.
Delhi.	Murree.
Mooltan.	Ludhiana.
Rawalpindi.	Sirsa.
Sialkot.	Simla.

The last-mentioned station, Simla, is independent of the Meteorological Department, and is established at the Quartermaster General's Office at Simla, where the observations are

made by the officers of the staff. The instruments were furnished in part from the Calcutta Office and have been duly verified, as are all others in use at the Punjab stations. Observations are not made on Sundays and public holidays, which is to be regretted.

A list of the Superintendents and Observers at the several stations is given in the Appendix C. II.

Six observatories, *viz.*, Rawalpindi, Delhi, Simla, Ludhiana, Sialkot, and Mooltan, have been inspected during the year; the two first by Mr. Eliot as Officiating Meteorological Reporter to the Government of India. I have, however, no detailed report of their condition. The barometers at Ludhiana and Delhi were found to be defective in working, and, together with those at Sialkot and Mooltan, which were instruments of a similar kind, have now been replaced by small Casella's standards sent up from Calcutta.

The observatory at Ludhiana was removed from the Police Hospital to the Jail of the same station, on the 3rd May 1878.

OBSERVATORIES IN THE CENTRAL PROVINCES.—I have received no special report on the condition of these observatories. Their number is the same as in the previous year, *viz.*, three of the second and eight of the third class. These are—

Second Class.

Nagpur. | Jubbulpur.
Pachmarhi.

Third Class.

Saugor.	Khandwa.
Seoni.	Raipur.
Hoshangabad.	Sambalpur.
Chanda.	Sironcha.

The names of the Superintendents and Observers are given in the Appendix D. Judging from the character of the registers, the work of these observatories is, in most cases, satisfactory. With the possible exception of Saugor, such defects as have been remarked are apparently due to want of care, arising from deficient training on the part of the observers. In the case of Saugor, however, the barometric readings are very doubtful. Not only do they entirely fail to accord with those of neighbouring stations when all are reduced to sea-level values, being almost constantly in excess, but the changes reported appear to be equally discordant, and I have been obliged to reject the whole from the barometric data of the year. At Nagpur, the readings of the nocturnal radiation thermometers for three months have been rejected, the readings being evidently erroneous. It is probable that this has arisen from a separation of the column, which the observer has neglected to notice and rectify.

Unfortunately most of the stations in the Central Provinces are difficult of access, and it has not yet been practicable either for Mr. Eliot or myself to inspect some of them personally. The general accordance and consistency of the registers is therefore the only criterion by which their work can be judged; and this fact is the more to be regretted that some of the least accessible lie in a part of India but poorly represented by observatories, and yet of great importance in a meteorological point of view, owing to its influence on the general meteorology of Northern India. Mr. Eliot visited Khandwa and Hoshangabad, and found these observatories in satisfactory condition.

OBSERVATORIES IN BERAR.—Of these there are four, all working on the system of third class stations, *viz.* :—

Third Class.

Akola.	Chikalda.
Buldana.	Amraoti.

excluding Makhla, which is an observatory of the Forest Department. They are immediately supervised by the Sanitary Commissioner of the Province, aided by Mr. F. Chambers. Since Mr. Chambers' inspection last year, the work of these observatories has been much improved, and except in one point, as regards Amraoti and Buldana, their registers are quite satisfactory. This exception is the persistent anomalies shown by the barometric readings of the two stations. While the register of the Akola barometer accords well with those of Khandwa, Nagpur, and other stations around, that of Buldana is persistently about 0·1 inch too high for the assigned elevation, and that of Amraoti somewhat too low. I do not think that in either case the anomalies can be accounted for by any atmospheric peculiarity, and it seems most probable that there is some error in the assigned elevations of the two stations.

The station at Makhla is established by the Forest Department, being furnished with verified instruments from this Office. Its registers have not yet been communicated to this Office.

The names of the Superintendents and Observers at the stations in Berar are given in Mr. Chambers' report in the Appendix E.

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—Until within the last three years, this area was one of the least represented in the Indian system. It now possesses seven observatories, all of the third class, *viz.* :—

Third Class.

Sutna.	Indore.
Neemuch.	Ajmere.
Nowgong.	Mount Abu.
Bikanir.	

The Sutna and Ajmere registers are communicated to the Meteorological Reporter for the North-Western Provinces, and the observatories are under his inspection. That of Nowgong, which is established on the voluntary system, sends the registers to the Calcutta Meteorological Office, and the remainder are under the Meteorological Reporter for Bombay and Rajputana.

The observatory at Bikanir is of exceptional importance, as it is situated in the middle of the desert tract, and is the only observatory that furnishes data for the climate of this interesting region in its full development. Its exact elevation is as yet unknown; but what is probably a near approximation has been obtained from the barometric readings of a whole year, compared with those of Ajmere, Sirsa, Mooltan, Jacobabad, Hyderabad, and Deesa—stations which, together, encircle the desert tract.

Mr. Hill inspected, during last year, the two observatories of Sutna and Ajmere. The former is under the very careful superintendence of Dr. S. J. Goldsmith, and everything was found to be in excellent order. That of Ajmere was, however, found to be in a very unsatisfactory condition. The situation is bad, to begin with; and the baro-

meter, which, three years ago, Mr. Eliot had himself removed from the thermometer shed to the inside of the Jail office, had been brought back to its former position, in complete disregard of the standing rules and instructions, which are in the hands of every observer. It is desirable on every account to remove this observatory and place it under proper superintendence; and with the assistance of the Commissioner, Mr. Sanders, arrangements are now in progress for removing it to the Kacheri, which is in an open situation and at a higher elevation than the present site.

The observatory of Mount Abu was inspected by Mr. F. Chambers, who reports that everything was found in good order, except that the north line of the wind vane was 7° in error. The observer did not know how to read his anemometer correctly, but Mr. Chambers instructed him in this part of his duty before his departure.

The comparison of the daily observations shows that, with the exception above noticed, the work of the observatories is generally satisfactory.

Excepting Nowgong, the names of the Observers and Superintendents at the above observatories are given in the North-Western Provinces and Bombay lists. (Appendices B. II. and E).

In the autumn of last year, an offer was made by the Commissioner of Inland Customs, Mr. Halsey, through Mr. Hume, to establish observatories at Sambhar and Pachbudra in the neighbourhood of the Sambhar Salt Lake in connection with the salt offices. This offer was accepted, the more readily that this part of Rajputana is at present represented only by Ajmere; the elevated position of which, immediately under the hills, renders it very far from a good representative of the country to the westward Instruments were supplied shortly after the close of the year, but registers have not yet been received.

OBSERVATORIES IN THE BOMBAY PRESIDENCY.—In the Bombay Presidency, there are now altogether fifteen observatories; *viz.*, one first class, four second class, and ten of the third class, including two, *viz.*, Satara and Karwar, at which the observers are volunteers. These are—

First Class.

Bombay (Colaba).

Second Class.

Belgaum.	Deesa.
Poona.	Kurrachee.

Third Class.

Jacobabad.	Satara.
Rajkot.	Bhuj.
Sholapur.	Malegaon.
Hyderabad.	Ratnagiri.
Surat.	Karwar.

The Colaba observatory is quite independent of the Meteorological Department, and only furnishes a register in the same general form as that kept at other observatories. A register in abstract and daily observations are also furnished by the Goa observatory, which may be reckoned physically as belonging to the Bombay Presidency. The Satara observatory has been furnished during the year. At this station, the observations are recorded by a volunteer. Self-recording anemographs on Beckley's principle have been

furnished to two of the second class observatories, *viz.*, Deesa and Belgaum, and a Casella's anemograph to Poona. Those at Deesa and Poona are now in position, but that at Belgaum awaits the construction of a tower. Mr. Chambers reports that these instruments reached him more or less broken and damaged; which he attributes either to faulty packing or rough usage. It must unquestionably have been the latter, in the transit from the Meteorological Office at Calcutta to that at Colaba, since they were in perfect order when they left the former office, and they had not been removed from the cases in which they had arrived from London. They were repaired, before being sent from Bombay, by the kind assistance of Colonel Fuller, the Superintending Engineer, Bombay. An additional Casella's anemograph was furnished to Mr. Chambers, but it is not required for Kurrachee, as there is already an instrument on Beckley's principle at Kurrachee Harbour, erected by the Great Trigonometrical Survey, for use in connection with the tidal observations; and three years of the traces of this instrument have lately been reduced and discussed by Mr. F. Chambers.

There is still some uncertainty about the elevation of one of the Bombay stations, *viz.*, Malegaon, judging from the readings of its barometer; and there appears to be some cause of error affecting the barometer at Ratnagiri, the readings of which appear to be somewhat too low, as compared with those of Bombay on the one side and Goa on the other. In such cases it is not easy to distinguish between the effects of erroneous elevation or an erroneous position or method of reading the instrument, and those of a persistent local barometric depression. The anomalous readings of the Malegaon barometer may possibly be due to the latter cause, since, during the last and present years, Khandwa, which, though very differently situated, is at no great distance to the north-east, has shown a similar anomaly[1]; but I cannot think this probable in the case of Ratnagiri; and I still think that the readings are affected by some constant but as yet undetected cause of error, either in the elevation of the instrument, or in its condition or use. Similar errors, one of excess and one of defect, appear to affect two stations in Berar, *viz.*, Buldana and Amraoti, so that it is necessary to reject them in tracing the course of the isobars.

Mr. Chambers has inspected eight stations in Bombay, besides Mount Abu in Rajputana (as has already been mentioned). The detailed report of the results of his inspection is given in the Appendix. At Malegaon, he found that, as at Ajmere, the barometer had been placed in the observatory shed. It is an instructive illustration of the prevailing ignorance of the action of meteorological instruments, that this error is so frequently made; with the idea apparently of giving the barometer proper exposure; and although in the printed instructions issued to all observers, a warning against the practice is repeatedly given and emphasized, and its prejudicial consequences pointed out, certain Superintendents occasionally persist in following it. At Deesa the anemograph was found to have been injured, but was rectified by Mr. Chambers. The minimum spirit thermometer was also out of order; although this again is a contingency which the observers are specially warned of in the printed instructions, in which the method of rectifying the instrument is described. The observer was also found to be reading his barometer in an erroneous manner. At Surat a minimum spirit thermometer was found in

[1] This station was visited by Mr. Eliot in order to ascertain the cause of the low readings of the barometer, but the instrument was found to be in perfect order and properly read; and the elevation is the same as before the anomaly showed itself in the registers.

the same state as that at Deesa. At Kurrachee the observer was absent for musketry practice, and the observatory closed. This inconvenience, which entails an interruption of the observations for three or four weeks, has also been experienced this year, at other observatories, at which there are soldier-observers; and unless it can be prevented in future years, it will be necessary to discontinue the employment of soldiers in this capacity. At Hyderabad, the barometer and nocturnal radiation thermometer were found to be out of order; and at Jacobabad the wet bulb had been allowed to become partially dry. With these exceptions, the instruments were in good condition.

It is somewhat unsatisfactory to notice, not at the Bombay stations only, but also at some other places, as is evidenced in Mr. Hill's report, how little attention some observers pay to the detailed printed instructions that have been drawn up for their guidance. It appears that in certain cases, no written or printed directions, however emphatic and detailed, will suffice to ensure the observations being properly made; and frequent inspection of stations by the reporters themselves is indispensable to secure this end.

OBSERVATORIES IN MADRAS, MYSORE, AND HYDERABAD.—As has been the case in previous years, I have received no reply to the request, forwarded on the 27th February last, that I might be furnished with a report on the working of the Madras stations during the year. I believe, however, that no change has been made in the working. I have already mentioned that, as far as I am aware, no steps have been taken to establish the observatory at Mangalore, which was sanctioned in 1875; and the persistent delay to provide this much-required station is very deeply to be regretted.

As Mr. Eliot has remarked in his report for last year, the west coast of India is far less provided with stations than that of the Carnatic and the Northern Circars. From Cochin to Goa, a distance of 400 miles, there is not a single observatory to show the distribution of pressure, the wind variation, or any element of climate other than rainfall; nor is the interior of this part of the country better provided. With the exception of Wellington, which, being a hill station, is valueless for the purpose of showing pressure, temperature, &c., at the lower level of the plains, no observatory exists in the western half of the peninsula between Belgaum and Coimbatore (an interval of about 380 miles); and the meteorological characters of this part of India, as shown on the daily charts, are consequently a matter of extreme uncertainty. When visiting Madras at the beginning of last year, I urged these considerations on Mr. Pogson, and understood from him that he would at once take steps to establish the observatory at Mangalore; but hitherto nothing has, I believe, been done. Mr. Eliot was unable to visit Madras in the past cold season, and therefore to carry out his intention as expressed in his report for last year. I am therefore taking steps to establish this much-required observatory in anticipation of a visit to the station, and I shall endeavour to inspect it as soon as possible after it has been brought into working condition.

Nor, as far as I have any information, has anything been done to establish the two stations, Bangalore and Trichinopoly, on the footing of second class stations. No hourly observations are recorded there, and no synoptic observations are furnished. At present, therefore, all the Madras stations are working on the system of third class stations, with the addition of a set of observations, at 10 P.M.; while the observers receive

Rs. 40 each per month instead of Rs. 15, as at third class stations in other parts of India. The following is a list of the stations :—

Third Class (Special system).

Madras.	Wellington.
Madura.	Secunderabad.
Coimbatore.	Trichinopoly.
Bellary.	Salem.
Negapatam.	Bangalore.
Cochin.	Masulipatam.

In addition to which is the private observatory of Mr. A. V. Nursingrow, which contributes registers, on the old system of stations of the

Second Class.

Vizagapatam.

The Madras observatory works on the same system as the other stations, with the exception that the wind is recorded by a Beckley's anemograph; and the hourly observations, which have been recorded for 20 years, furnish the means of applying an accurate mean correction for the diurnal variations.

It was proposed in the scheme for the re-organization of the Meteorological Department in 1875 that the observers at the Madras stations should reduce their own registers, and that after examination by the Meteorological Reporter for Madras, they should be forwarded to my office; thus preventing for the future those great delays in the utilization of the Madras returns which have been the subject of frequent comment. This, apparently, has never been done, and the receipt of the Madras returns is now more in arrear than it has been at any time since the re-organization of the department. It is urgently necessary to take some decisive steps to remove this evil, unless indeed the meteorology of Madras is to be excluded from the general report on the meteorology of India, or the publication of that report is indefinitely deferred.

Mr. A. V. Nursingrow, of Vizagapatam, continues to communicate his very important registers of his observatory, and furthermore transmits a daily weather telegram to the Calcutta Office, and also to Simla when the daily weather reports are issued from that station.

OBSERVATORIES IN BRITISH BURMA.—All the observatories sanctioned for British Burma in 1875 have furnished registers for the whole of the past year, in addition to the telegraphing station of Diamond Island, sanctioned in January 1878. They are as follow :—

Second Class.

Rangoon.

Third Class.

Bassein.	Diamond Island.
Tounghoo.	Thyetmyo.
Moulmein.	Mergui.

Akyab.

Of these, Akyab is under the Meteorological Reporter for Bengal, and Diamond Island under the Reporter for India; the remainder under the local superintendence of the Sanitary Commissioner, who forwards the registers to my office for examination and reduction.

The observatory at Rangoon is established at the High School, the observations being recorded by one of the masters with an assistant; and the whole is under the superintendence of the Junior Civil Surgeon, who receives Rs. 30 per mensem for the duty, as at other stations of the second class. In May 1878, a Beckley's anemometer was put up in a position selected for it by myself in 1876, and the traces have been sent to my office for measurement and tabulation.

In May last, the Sanitary Commissioner proposed that the observatory should be placed in the entire charge of Mr. Marshall, the observer, with an increase of pay, inasmuch as the Junior Civil Surgeon, who had nominal charge, seldom went near the observatory. The arrangement to place Mr. Marshall in charge, as proposed, was approved by Mr. Eliot, then officiating in my place, and on the same allowances as are drawn by E. T. Masters at second class stations acting in the like capacity; and he proposed to devote the savings to the establishment of two new observatories of the third class in Rajputana, in accordance with a proposal made by the Commissioner of Customs in that province. Some delay arose in the correspondence, and before the arrangement was settled in the Financial Department, the Sanitary Commissioner reported that, owing to the misconduct of the observer, the work of the observatory had been interrupted, that Mr. Marshall's services had consequently been dispensed with, and another observer appointed in his place. On further enquiry, the Sanitary Commissioner considered that, having regard to recent occurrences, it would be unwise to remove the superintendence from the charge of the Junior Civil Surgeon, and the observatory is therefore still carried on in accordance with the original arrangement.

The temperature registers of one month at Moulmein appear to be erroneous, but with these exceptions the registers of the Burmese stations during the past year have been of a satisfactory character.

OBSERVATORIES IN THE BAY ISLANDS.—The two observatories in the Andaman and Nicobar Islands, *viz.*—

Third Class.

Port Blair | Nancowry

have been carried on in a satisfactory manner on the same system as in former years. These stations are of very high importance, as they furnish the only registers which we possess at present for the Bay of Bengal. Their importance would, however, be very greatly enhanced, were telegraphic communication established between them and the mainland. Situated as they are, close to the birth-place of some of the most destructive cyclones that ravage the shores of India, the possibility of obtaining even occasional telegrams on emergency, from these stations, would be an addition of incalculable value to the storm-warning system; and it is to be hoped that this advantage will not be left unregarded, should it at any time become a question to lay an additional cable between any part of British India and the Straits Settlements, or to extend the line which now terminates at Diamond Island, in their direction.

EXTRA INDIAN OBSERVATORIES.—It has been observed in various former reports, that, in a meteorological point of view, India is in a great measure cut off from the remainder of Asia by the great encircling mountain ranges; but the influences of these ranges on its meteorology are not merely that of a barrier; the Indian slopes of the mountains are included in, and form an essential part of, the Indian system, and are the source of

the dry winds which play so important a part in Indian meteorology. These are not less deserving of being brought with the scheme of observation than the plains and plateaux which are directly or indirectly under British rule. Hence, from the first, it has been an object to establish observatories, whenever possible, in the frontier states, and one of these, *viz.*, Leh, has now been in operation as a second class station for nearly five years. In 1877, instruments were furnished to Dr. Duke, the Medical Officer in charge of the Khelat Mission, to establish an observatory of the third class at Quetta, in Bálúchistán. The observatory has been at work during the past year, but the registers are imperfect. A third observatory has been lately established in Gilgit, in latitude 36°, almost the most northerly point of the Cashmere Rajah's territory. Dr. J. Scully, whose excellent work with Mr. Shaw's Yarkand Mission has already furnished a most valuable contribution to our knowledge of the meteorology of this region, having been appointed Medical Officer to the Resident at Gilgit, volunteered to superintend the establishment of an observatory there, and having been furnished with a complete set of instruments, commenced observations in December 1878. It is now in contemplation to provide an allowance for the observer, as at other stations.

During the recent occupation of Afghanistan, an observatory was temporarily established at Jellalabad, but has now been reduced. Instruments have also been sent for observatories at Thull, the Kurram Fort, and the Peiwar Kotal; but none of these were in operation during the year under report.

The observatory at Bushire, on the Persian Gulf, has contributed registers very regularly. This is carried on by Colonel Ross, the British Resident at that station.

Owing to political disturbances, it has not yet been practicable to establish the proposed observatories at Bhamo and Mandalay in Ava. But the instruments for the purpose were sent in the early part of last year, and as soon as the country is again settled, steps will be taken to obtain observations from this region, the meteorology of which is certainly influential in affecting that of British Burma, and a knowledge of it, therefore, necessary to the comprehension of the latter.

At the close of the year (31st March 1879) there were thus four extra Indian observatories in existence in connection with the Department—

Second Class.
Leh
Third Class.
Quetta | Gilgit
Bushire

and one foreign observatory in the Peninsular, *viz.*, Goa, the Director of which, Señor Antonio Martins, communicates monthly abstracts of his registers to this department, and also transmits a daily weather telegram.

RAIN-GAUGE STATIONS.—The observatories enumerated above do not include the very numerous stations at which the rainfall alone is registered. Rain-gauges are now established at all district and sub-divisional stations, Tehsildaris, &c., in the Regulation Provinces, and at a considerable number of stations in the Native States. Only a certain selection from their registers are given in the Annual Report of the Meteorology of India; and these are received in some cases from the Provincial Reporters: in others from the administrative officers of the different provinces. Considerable additions have been made to the selected stations during the past year.

METEOROLOGICAL OFFICERS AND OFFICE WORK.

The general control of meteorological observatories and offices in the different provinces, during the past year, has been in the hands of the following officers :—

Province.	Superintending Officer.	Names.
Bengal and Assam ...	Meteorological Reporter to the Government of Bengal	J. Eliot, M.A. A. Pedlar (officiating).
North-Western Provinces ...	Meteorological Reporter to the Government of North-Western Provinces	S. A. Hill, B.S.C.
Punjab	Meteorological Reporter to the Government of Punjab	A. Neil, M.D.
Central Provinces ...	Sanitary Commissioner	Dr. J. Brake.
	Meteorological Reporter to the Government of India	H. F. Blanford. J. Eliot, M.A. (officiating).
Berar	Sanitary Commissioner	Dr. Abbott.
	Meteorological Reporter for Bombay, &c. ...	F. Chambers.
Central India and Rajputana	Meteorological[1] Reporter to the Government of North-Western Provinces	S. A. Hill, B.S.C.
	Meteorological Reporter for Bombay, &c. ...	F. Chambers.
Bombay	Ditto ditto ditto ...	Ditto.
Madras	Meteorological Reporter to the Government of Madras	N. R. Pogson.
Burma ...	Meteorological[2] Reporter to the Government of Bengal	J. Eliot, M.A. A. Pedlar (officiating).
	Sanitary Commissioner	Dr. Kelly.
	Meteorological Reporter to the Government of India	H. F. Blanford. J. Eliot, M.A. (officiating).
Bay Islands	Senior Medical Officer, Port Blair ...	Dr. J. Dougall.
	Meteorological Reporter to the Government of India	H. F. Blanford. J. Eliot, M.A. (officiating).
Extra-Indian Observatories	Meteorological[3] Reporter to the Government of Punjab	A. Neil, M.D.
	Meteorological Reporter to the Government of India	H. F. Blanford. J. Eliot, M.A. (officiating).

[1] Two stations. [2] One station. [3] One station.

The registers are in all cases reduced and examined by the several Meteorological Reporters, and thus the Reporters deal either partially or solely with the following number of stations in each case:—

Meteorological Reporter to the Government of India ...			...	28 stations[1]	
Ditto	ditto	ditto	Bengal ...	19 ,,	[2]
Ditto	ditto	ditto	North-Western Provinces	15 ,,	[3]
Ditto	ditto	ditto	Punjab	12 ,,	[4]
Ditto	ditto	ditto	Madras	12 ,,	
Ditto	ditto	for Bombay, Rajputana, &c.		... 23 ,,	[5]

In Bengal, the North-Western Provinces, and Madras, the Meteorological Reporters superintend also the numerous rainfall registers of the district and sub-divisional stations of their respective provinces, and prepare weekly returns of the rainfall, and in Bengal an important part of the Reporter's work is the control of the system of telegraphic report from stations around the shores of the Bay, for the purpose of storm warnings, and the issue of daily reports. The more extensive system of daily telegraphic and postal reports from all stations (established as a system of postal report only in 1877 and partly converted into a telegraphic system last year) is controlled by the Meteorological Reporter to the Government of India.

During the greater part of last year (from the 9th April 1878 to the 17th February 1879), the duties of Meteorological Reporter to the Government of India were discharged by Mr. J. Eliot, M.A., and Mr. A. Pedlar officiated for Mr. Eliot as Meteorological Reporter to the Government of Bengal; and it was during Mr. Eliot's tenure of the office that the chief measure of the year was carried out, *viz.*, the organization of the daily system of report by telegraph.

The Calcutta Office establishment, as well as that of the Meteorological Reporter for Bengal, has continued under the immediate management of Babu Fanindra Mohan Basu. I am glad to be able to repeat the expressions of commendation with which Mr. Eliot referred to his services in the report of last year, and to express my entire approval of the orderly and regular conduct of the office under his charge. The Head Computer, Babu Brojomohun Rakhit, is also deserving of special mention for the excellence and trustworthiness of his work. On one or two occasions, in the absence of Babu Haran Chundra Mookerjee, he has taken charge of the observations for the time-ball signals, for which work he has rendered himself perfectly competent.

The general increase of current work, both in my own office and in those of the local Reporters, has rendered it impossible to execute the whole with that despatch which is desirable; and this necessarily very much curtails the power of the department to utilize the rapidly accumulating data. This is the more to be regretted, because our comprehension of meteorological processes is the measure of our ability to turn the contemporary observations to useful account, whether in predicting weather or in forecasting the seasons; and while we have at least three officers besides myself in the department, who

[1] One each in Bengal, Madras, and Central India, two in the North-Western Provinces, eleven in the Central Provinces, seven in Burma, two in the Bay Islands, and three extra-Indian.

[2] Fifteen in Bengal, three in Assam, one in Burma.

[3] One in Central India (Baghelkand), one in Rajputana, the remainder in the North-Western Provinces.

[4] One extra-Indian, the remainder in the Punjab.

[5] Five in Berar, four in Central India and Rajputana, the remainder in Bombay.

have given proof of their ability and desire to aid in the advancement of general meteorological knowledge, all work of the kind requires a considerable amount of tabulation and computation, which can be equally well performed by assistants, but which the existing establishments can carry on but to a very limited extent. I am of opinion that it is therefore highly important, in the general interests of the work, that the Reporters should have some special assistance in addition to that which was provided for working the current reductions of the registers, and I am in hopes that so soon as the improvement of financial prospects shall permit of a small amplification of the Reporters' Offices, some provision may be made for the above purpose. Even with their present limited means, some very valuable discussions of meteorological phenomena have been worked out by Messrs. Eliot, Hill, and F. Chambers, some of which have already appeared in the Indian Meteorological Memoirs and in special reports; and others are in course of passing through the press. But the field of work is very large and suggestive, and any additional assistance which may be provided will proportionately increase the outturn of this important work.

In the course of last year, the engagement of a trained European Assistant was sanctioned for the purpose of giving a further extension to the system of daily reports, by the publication of weather charts, to accompany the present tabular and verbal statements. An officer of the London Meteorological Office was selected and well recommended by Mr. R. H. Scott, the Secretary to the Meteorological Council of the Royal Society. But the salary offered was insufficient to compensate him for giving up the post which he at present holds, for an appointment in India, and no other qualified candidate has been found. Meanwhile the financial pressure has rendered it necessary to restrict all expenditure within the narrowest working limits, and the engagement of an Assistant, together with the proposed publication of weather charts, has necessarily been postponed for the present.

The publications of the office may be reviewed under the heads of—

Daily Reports.
Annual Report.
Other publications.

Daily Reports.—The system of daily reports of the weather in all parts of India and Burma was set on foot by Mr. Eliot on the 15th June 1878. In the previous year, a preliminary essay had been made with a view to this work, by establishing a system of daily report by post from all observatories, which reports were forwarded direct to my office in Calcutta, reduced in general tables, one for each day, and the barometric, wind, thermometric, and rainfall data laid down on daily charts. In this way an aperçu of the weather changes was obtained, which showed the high value of the system; but the results of the work were necessarily restricted to the office; and as from ten days to a fortnight elapsed before even the data for the continental area could be brought together, the system was of little value for affording information of the current weather changes.

The change from this system to that of reporting by telegraph from a certain number of stations was made at Mr. Eliot's suggestion in May last, in consequence of a letter from the Irrigation Department, asking for early information respecting the rainfall. The proposed scheme having received demi-official sanction on the 30th May, Mr. Eliot, then at Simla, hastened to Calcutta to carry out the requisite arrangements.

The system of telegraphing hitherto followed for the storm warnings being unnecessarily cumbrous and expensive, had to be reformed, so that each weather telegram should consist only of six words (exclusive of the address). In conjunction with Mr. Pedlar, Mr. Eliot drew out a telegraphic code, based on the system adopted in the American weather signal service, but much modified to suit the local requirements. The code was drawn up, and the requisite instructions were issued to the meteorological observers within a week after Mr. Eliot's arrival in Calcutta. He then returned to Simla with a small office establishment, and the first report was published on the 15th June. In consequence of certain objections made by the Department of Public Works to the proposed method of transmitting telegrams, the service did not, however, come into complete working order till the last week of the month. During the remainder of the season, it worked smoothly, and gave early and valuable information to the Government. The various observers concerned transmitted the observations with great regularity and accuracy; and the quickness with which the weather service was established in full working order, is very creditable to the observers of the Department. During the rainy season, a daily report was published, giving the observations taken at 10 A.M., and a short summary describing the chief features of the weather during the previous twenty-four hours over the whole of India. It was printed in the evening or early next morning and circulated on the following morning to the several officers and Government officers in Simla.

In addition to this, a weekly summary of the weather was published in the *Gazette of India*.

The service, as originally sanctioned, was to terminate at the end of the rainy season; but it was found to be of such value, that at the close of the season, its continuance was sanctioned to the end of the financial year, and again a further sanction was given at the close of the year, pending the consideration of a report which should provide for its permanent establishment. The scheme now submitted, provides for the extension of the system of telegraphic reports to 84 observatories, that is to say, to all meteorological stations that have telegraphic communication, and in addition to these, it is proposed to obtain telegrams reporting the rainfall from 35 stations, each of which shall receive from four or five neighbouring stations within one day's post, postal reports of the rainfall, which the local Electric Telegraph Masters will combine in one telegram, according to the code, and transmit to Calcutta or Simla, according as the one or the other is the place of publication for the time being.

At present the issue takes place at Simla, and the general remarks which were discontinued as a part of the daily report during the winter and spring months, have now been resumed. The duty of drawing up this falls at present on the Reporter to the Government of India, and as the reports are issued on all days, Sundays and Holidays included, he is necessarily bound down to the station of issue for so long as the reports are continued. As a temporary measure, this matters but little, but it of course prevents his inspecting observatories or absenting himself for any purpose whatever; and all work of this kind must therefore stand over till the cold weather, when again the general remarks must be discontinued. The proposal to combine a weather chart with the daily reports, must also be deferred until an assistant can be provided to superintend the work; as the time that this addition would require cannot be spared from the other duties of his office.

A daily chart is, however, drawn out by the mechanical draughtsman attached to the office for this purpose, the isobars and isotherms being laid down by myself, and these are filed for future reference.

Annual Report.—The report on the meteorology of 1877 prepared by Mr. Eliot, was issued in February 1879. It would have been issued earlier, but for his time being much occupied by the duties connected with the organization and practical working of the daily report system. The delays which, in previous years, have arisen from the slowness of printing the large mass of tables which form the appendices to the report, were in a measure overcome, by having one of the appendices printed at the Thomason College Press at Roorkee. In order to make arrangements for the execution of this work, Mr. Eliot visited Roorkee in May 1878.

The report is issued in the same form as those of previous years; but partly owing to the greater extension of the letter-press descriptions, partly to the increase in the number of stations that furnished observations for 1877, it is more bulky than either of its predecessors. It includes a general description of the meteorological features of the year, with comparative tables showing the average values of the several meteorological elements derived from past years, and the anomalies or differences in 1877, descriptions of the newly established stations, and the geographical co-ordinates and elevations of all stations. The appendices give the monthly and annual means and ranges, and the highest and lowest readings of the sun and nocturnal radiation thermometers, air temperature, and barometric pressure at from 95 to 108 stations in each case: monthly summaries of the wind directions and velocities, the temperature of the wet bulb, with the computed vapour tensions and humidities, and the proportion of clouded sky, also in the form of monthly means of the observations: and the monthly and annual rainfall and number of rainy days at 311 stations. Another appendix gives the original observations, reduced and corrected, of the six stations, Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras. The report is illustrated by 12 charts in colored lithography showing the mean distribution of temperatures, atmospheric pressure, and wind direction in each month of the year.

The report for 1878 is now in course of preparation, and a part is already in the press. It will give as a new feature, a map of India showing the positions of all meteorological observatories according to their class, as first, second, or third class stations, and also all stations from which the rainfall only is given in the Annual Report. It is to be feared that this report will be considerably delayed by the hitherto unprecedented delay in the communication of the Madras registers; a large portion of which have as yet (in July 1879) not come to hand. This delays the preparation of all work connected with the report. The charts cannot be lithographed, the tabular data, otherwise long since completed, cannot be sent to the press, nor can the general description of the features of the year be fully written, so long as the data are wanting for an important portion of the peninsula. The necessity of taking some steps to obviate the repetition of these delays, which occur only in the case of Madras, has been represented to Government, and it is to be hoped that before the expiration of the year, the work of the Madras Office may be placed on an improved footing as regards rapidity of execution.

According to a notice that lately appeared in the Journal of Austrian Meteorological Society, under the very competent editorship of Professor Hann, the annual volume

on the meteorology of India now ranks with that of the Russian Empire in the extent and comprehensiveness of its data, and it appears at a very much earlier date.

Other publications.—During my absence in England, Part II of the Indian Meteorological Memoirs was issued, and was noticed in Mr. Eliot's Report of last year. A third part, including two papers, *viz.*, one by Mr. S. A. Hill on cyclical variations of the rainfall of Northern India, and also a paper by myself, discussing Dr. J. Scully's observations in Western Tibet, is now nearly ready for issue. Mr. Eliot has also published a report on the Madras cyclone of May 1878, which was originally intended to appear in the same part of the Memoirs, but having, by an oversight, been separately paged, it was issued in an independent form.

A valuable paper by Mr. F. Chambers, discussing the anemographic registers of three years in Kurrachee, has lately been received, and will be published in Part IV of the Memoirs.

A short paper by myself on the diurnal variation of the rainfall of Calcutta was communicated to the Asiatic Society of Bengal in November 1878, and appears in the Journal of the present year.

A very valuable report on the rainfall of the North-Western Provinces, drawn up by Mr. S. A. Hill, has recently been presented to the Government of the North-Western Provinces; but this will be more fitly noticed in the report of the current year.

Other work now in preparation is the discussion of the rainfall registers of the whole of India in past years. A short special report, giving some preliminary information on this subject, was drawn up for the Famine Commissioners shortly after my return to India, and similar short reports on the rainfall of the several provinces had previously been prepared and communicated by the local Reporters for Bengal, the North-Western Provinces, the Punjâb, and Bombay.

LIBRARY.

The library is slowly but steadily increasing, chiefly by presentation and exchanges with various meteorological institutions in other parts of the world. It now completely fills three large double book cases, and is in excellent condition. It consists of bound volumes and a large number of pamphlets and portions of periodical publications and printed and manuscript charts, filling a large set of map slides. The additions during the past year are enumerated in the following list:—

Presentations to the Library from the 1st April 1878 to the 31st March 1879.

Place.	Donor.	Title of Work.
Adelaide ...	C. Todd, Esq., Director of the Observatory.	Meteorological Observations made at the Adelaide Observatory, for the years 1876 and 1877, and January to May 1878.
Amsterdam	Royal Academy of Sciences ...	Verslagen en mededeelingen afd Natuurkunde, vol. XI, Jaarboek, 1876.
		Processen Verbaal, 1876-77.
		Verslagen en mededeelingen afd Letterkunde, vol. VI.
		Carmina Latina.
		Verhandelingen afd Letterkunde, vols. IX and XI.
		Verhandelingen, vol. XVII.

Presentations to the Library from the 1st April 1878 to the 31st March 1879—continued.

Place.	Donor.	Title of Work.
Batavia ...	Dr. Bergsma ...	Bijdrage tat de kennis der weersgesteldheid ter kuste van Atjeh.
		Influence of the Moon's Phases on the Temperature of the Air at Batavia.
Berlin ...	Dr. Gustavus Hellman, Meteorologisches Institut.	Die täglichen Veränderungen der Temperature der Atmosphäre in Norddentschland.
		Feuchtigkeit und Bewolkung auf der Iberischen Halbensel.
		Uber die Sommerregenzeit Deutschlands.
Bombay ...	Government of Bombay ...	Thirteenth Annual Report of the Sanitary Commissioner for the Government of Bombay, 1876.
		Fourteenth Annual Report of the Sanitary Commissioner for the Government of Bombay, 1877.
		Reports on Military Cantonments and Civil Stations in the Presidency of Bombay inspected by the Sanitary Commissioner in the years 1875 and 1876.
		Report on the Administration of the Meteorological Department in Western India for 1877-78.
,, ...	Meteorological Reporter ...	Brief Sketch of the Meteorology of the Bombay Presidency in 1877.
Brussels ...	Academie Royale de Belgique	Bulletins, 2nd Series, Tomes XLI—XLV.
		Annuaire, 1877 and 1878.
,, ...	Observatoire Royal ...	Annales de l'Observatoire Royal de Bruxelles, June to August 1877 and January to October 1878.
		Meteorological Observations at other stations, November and December 1877, and January to March 1878.
		Meteorological Means of 1877, with title page, &c.
Budapest ...	K. K. Central Anstalt für Meteorologie und Magnetismus.	Jährbücher, Bände V and VI, Jahrgänge 1875 und 1876.
Calcutta ...	Government of India, Department of Revenue, Agriculture and Commerce.	General Report on the Operations of the Great Trigonometrical Survey of India during 1876-77.
		General Report on the Marine Survey of India, 1876-77.
		Meteorology of the Bombay Presidency, with diagrams and maps by C. Chambers, Esq.
		Indian Surveys, second edition.
,, ...	Government of Bengal ...	Statistical Account of Bengal, vol. XX, parts I and II.
		Report on the International Trade of Bengal for the year 1877-78.
		Tenth Annual Report of the Sanitary Commissioner, Bengal, for 1877.
		Administration of Bengal, 1877-78.

Presentations to the Library from the 1st April 1878 to the 31st March 1879—continued.

Place.	Donor.	Title of Work.
Calcutta ...	Geological Survey of India ...	Memoirs of the Geological Survey of India, vols. XIV and XV, part I.
,, ...	The Rev. S. Lafont, S.J. ...	Results of Observations taken at the St. Xavier's College Observatory, from July to December 1873, January to June 1874, January to June and July to December 1877, and January to June 1878.
,, ...	Sanitary Commissioner with the Government of India.	Vital Statistics of India, vols. IV and V.
Canada ...	Meteorological Office, Canada	Seventh Annual Report of the Meteorological Service of the Dominion of Canada.
Carlsruhe ...	Baden Meteorological Observatory	Reports for 1869 to 1877.
Copenhagen ...	L'Institut Météorologique Danois.	Bulletin Météorologique du Nord, February to December 1878 and January 1879.
		Annuaire Météorologique pour l'année, 1876, part II, and 1877, part I.
,, ...	Royal Danish Academy of Sciences.	Oversigt, No. 3 of 1876, Nos. 1 and 3, 1877, and No. 1, 1878.
Edinburgh ...	Astronomer, Royal Observatory	Edinburgh Astronomical Observations, vol. XIV, 1870—77.
,, ...	Scottish Meteorological Society	Journal, New Series, Nos. LI—LVI.
Hamburgh ...	Deutsche Seewarte ...	Monatliche Uebersicht der Witterung; November and December 1876 and October to December 1877.
Havanna ...	Observatorio del real Colegio de Belen.	A Puntes relativas a las Huracanes de las Antillas en Setiembre y Octobre de 1875 y 1876.
Hong-Kong ...	Government of Hong-Kong ...	Meteorological Observations taken at the Government Lock Hospital, Hong-Kong, from February to December 1878 and January 1879.
Leipzig ...	Professor C. Bruhns ...	Meteorologische Beobachtungen in Deutschland in 1876.
Lisbon ...	Royal Academy of Sciences ...	Memorias da Academia, Classe de Sciencias Moraes, Politicas e Belles Letteras, Tomo IV, part 2.
		Memorias da Academia, Classe de Sciencias, Mathematicas, Physicas e Naturaes, Tomo V, part I.
		Jornal de Sciencias, Mathematicas, Physicas e Naturaes, Tomo V.
		Jornal de Sciencias, Mathematicas, Physicas e Naturaes, Nos. 21 to 23.
		Historia das Estabelecimentos Scientificas, Litterarias Artisticas, Tome IV to VII.
		Curso de Meteorologica.
		Tratado Elementar de Optica.
		Sessão Publica, 1875—77.

Presentations to the Library from the 1st April 1878 to the 31st March 1879 —continued.

Place.	Donor.	Title of Work.
London ...	Meteorological Office ...	Weekly Weather Report, vol. I, Nos. 1—19, 21—32, 35, 37, 39—41, 43, 44 and 47.
		Weekly Weather Report, vol. II, Nos. 5, 6, and 7.
		Hourly Readings of the Seven Observatories from June to December 1877 and January, February, and June 1878.
		Quarterly Weather Reports, parts III and IV, 1875.
		Ditto ditto, parts III and IV, 1877.
		Meteorological Observations at Stations of the Second Order, part II, 1876, and part I, 1877.
		Weather Reports, January to June 1878.
		Reports to the Permanent Committee of the Meteorological Congress.
		Meteorology of the North Atlantic during August 1873, illustrating the Hurricane of that month.
		Synchronous Charts of the North Atlantic during August 1873.
...	Secretary of State for India ...	Meteorology of the Bombay Presidency, with diagrams and maps, by C. Chambers.
		Abstract of the Report of the Surveys and of other Geographical Operations in India for 1876-77.
,, ...	Meteorological Society ...	Quarterly Journal, vol. IV, Nos. 25—28.
		List of Fellows of the Meteorological Society, 1st May 1878.
,, ...	The Publishers ...	The Colonies and India, Nos. CCXC, CCXCI, CCXCVII, CCCII, CCCXI, CCCXII, CCCXIII, and CCCXX.
,, ...	The Editor ...	Symons's Monthly Meteorological Magazine, March to December 1878, and January and February 1879.
,, ...	Society of Arts ...	Journal Nos. 1288, 1319—1369.
,, ...	Royal Society ...	Proceedings Nos. 184—189.
,, ...	General Sir Edward Sabine, R.A., K.C.B., F.R.S.	Contributions to Terrestrial Magnetism, No. XV.
,, ...	Kew Committee ...	Report of the Kew Committee for the year ending 31st October 1878.
		Comparison of the Standard Barometer of the Royal Observatory, Greenwich, and the Kew Observatory, by G. M. Whipple, B.S.C., Superintendent of the Kew Observatory.
		The Relative Duration of sunshine at the Royal Observatory, Greenwich, and at the Kew Observatory during the year 1877, by G. M. Whipple, B.S.C., F.R.A.S., F.M.S.

Presentations to the Library from the 1st April 1878 to the 31st March 1879—continued.

Place.	Donor.	Title of Work.
Melbourne ...	Observatory ...	Monthly Record of Results of Observations from August 1877 to October 1878.
		Results of Observation, &c., during 1875, together with abstracts of observations obtained in various localities in Victoria, vol. IV.
Meudon, Paris, ...	Mons. J. Jansen, Director, Physical Observatory.	Annuaire pour l'année 1879.
Mexico ...	Central Meteorological Observatory.	Bulletin, Tomo I, Nos. 87 and 88.
		Ditto, Tomo II, Nos. 1—41, 45—54, 56—61, 63—93.
		Ditto, Tomo III, Nos. 1—52, 54—79.
		Mexico Synoptic Observations, 16th November 1877 to 31st March 1878.
		Revista Meteorologica Mensuel, February to June 1878.
		Mexico, Contribution to the Bulletin of International Meteorological Observations taken simultaneously in April and May 1878.
Montsouris ...	Observatoire de Montsouris ...	Annuaire pour l'année 1879.
		Bulletin Mensuel, December 1877.
Munich ...	Meteorological Office ...	Instructionen für die Beobachter au den Meteorologischen Stationen im Königreich Bayern.
,, ...	Royal Academy of Sciences ...	Sitzungsberichte, 1871-78.
New Haven ...	Connecticut Academy of Arts and Science.	Transactions of the Connecticut Academy of Arts and Sciences, vol. I, parts 1 and 2. Vol. II, parts 1 and 2. Vol. III, part 2. Vol. IV, part 1.
New York ...	Meteorological Observatory ...	Annual Report, 1877.
Paris ...	Bureau Centrale Météorologique de France	Bulletin Internationale, XXIII, année, Nos. 17—58.
Perpignan, France	M. le Docteur Fines; President du Commission Meteorol. des Pyrénées Orientales.	Bulletin Météorologique des Pyrénées Orientales, 1872, 1873, 1874, and 1876.
		De la pluie dans les Pyrénées Orientales.
		Vent sa Direction et sa Force.
Perth (Western Australia).	Surveyor General	Meteorological Report for 1878.
Pesaro	Observatory	Sheets of Meteorological Curves, September 1877 to February 1878.

Presentations to the Library from the 1st April 1878 to the 31st March 1879—continued.

Place.	Donor.	Title of Work.
Philadelphia ...	Franklin Institute ...	Journal Nos. 627, 628, and 630—637.
Prag	K. K. Sternwarte	Astronomische Magnetische und Meteorologische Beobachtungen, 1877.
Singapore ...	Principal Civil Medical Officer, Straits Settlements.	Straits Settlements, Meteorological Return, 1877.
St. Petersburgh ...	Physical Central Observatory ...	Annaleu des Physikalischen Central Observatoriums, Jahrgäng 1876.
Sydney	Government Observatory ...	Meteorological Observations, June to September 1877.
Syracuse ...	R. Osservatorio Meteorologico de Seracusa.	Osservazioni Meteorologiche ; January to June 1878.
Tasmania ...	Royal Society	Results of Five Years' Meteorological Observations for Hobart Town, &c.
Tiflis	Observatoire Physique .	*Moritz.* Erreur dans la table de M. Regnault. Anwendung des Pistorschen Reflection kreises. Meereshöhe von Tiflis. Bewegungs Mechanismus des Drehthurmes. Sonnenfinsterniss vom 6 März 1876. Exercices Hypsometriques. Zwei Bemerkungen zu Regnaults Tafel. Schemacha und seine Erdbeben. Ueber die geographische Lage und die absolute Höhe der Stadt Teheran. Reflexions-Thermometer. Meteor. Beobachtungen in Tiflis, 1871—75. *Moritz & Keifer.* Sammlung von Hülfstafelm zur Berechnung barometerischer Hohenbestimmungen. *Keifer,* Erdbeben in Kaukasien in 1868. Biot's Barometer Tafeln. Magnetische Inclinationen in Tiflis, 1870 – 1876. *Abich.* Krystallinischen Hägel.

Presentations to the Library from the 1st April 1878 to the 31st March 1879—continued.

Place.	Donor.	Title of Work.
Turin	R. Osservatorio de Torino ...	Bolletino della Osservatorio Anno XII (1877). Indicazioni formale e tande numeriche per it calcolo delie effemeridi astronomiche di Torino cogli elementi della *Connaisance des Temps di* Parigi e del *Nautical almanach* di Greenwich memoria di Alessandro Dorna. Maniera de trovare dei formale generali pet calcolo della parallasse nelle co-ordinati di un astro conalcune semplici relazioni di trigonometria piana.
Upsala	Observatoire de l'Université d'Upsal.	Bulletin Météorologique mensuel, vol. IX, Année 1877. Atlas des Movements superieurs de l'atmosphére.
Utrecht ...	Royal Dutch Meteorological Institute.	Maandelijksche windkaarten van den Nord Atlantischen Oceaan, 1st and 2nd series. De Winden ov de kust van Atjeh. Gemiddelde Barometerstand en stormen rond Africas Zuidpunt. Zeitaanwijzingen van het kanaal naar Java. Jaarboek, Vol. II, 1873, and Vol. I, 1877.
Vienna	Royal Academy of Sciences ...	*Boehm.* Vegetabilischen Nährwerth d. Kalksalze. „ Veg. Gährung mit Wasserabsorption. „ Respiration von Wasserpflanzen. „ Gährungsgase v. Sumpf. und Wasserpflanzen. „ Stärkebildung in d. Chlorophyllkörnern. *Burgerstein.* Beziehung d. Nährstoffe zur Transpiration. *Boltzmann.* Einige Probleme d. mechan. Wärmetheorie. *Domalip.* Bestimmung d. Widerstände schlechter Leiter. *Ettingshausen.* Genetische Gliederung d. Cap-flora. *Fuchs.* Tertiärbildungen der Appenninen. *Goldschmidt* und *Ciamician.* Dampfdichten-Bestimmung. *Gradle.* Spannungsunterschiede zwischen d. linken Ventrikel u. d. Aorta. *Haberlandt.* Beiträge z. Kerztniss d. Lenticellen. „ Winterfärbung ausdauender Blätter.

Presentations to the Library from the 1st April 1878 to the 31st March 1879—concluded.

Place.	Donor.	Title of Work.
Vienna ...	Royal Academy of Sciences	*Haun.* Barometrische Hohenmessung.
		Hansel. Keimung d. Preissia commutata.
		Hering. Theorie d. Temperatursinus.
		Höfer. Erdbeben von Belluno.
		„ Lichenen Spitzbergens u. Novaja Semlja's.
		Höhnel. Samenschalen d. Cucurbitaceen.
		Leitgeb. Entwicklung d. Kapsel v. Anthoceros.
		Lippich. Theorie d. Electrodynamik.
		Moeller. Neue Formelelemente in Holzkörper.
		„ Entstehung d. Acacien-Gumim.
		Niessl. Kosmische Theorie d. Meteoriten.
		Peyritsch. Biologie v. Laboulbeniaceen.
		Tangl. Mikrochemie d. Pflanzenzellen.
		Tschermak. Vulcanismus als Kosmische Erscheinung.
		Velten. Phys. Beschaffenheit d. pflanzl. Protoplasma.
		„ Einwirkung Strömend. Electricität auf d. Bewegung d. Protoplasma.
		Wiessner. Bewegung d. Imbibitious wassers im Holze.
... ...	Prof. J. Hann	Zeitschrift der Oesterr. Gesellsch. für Meteorologie, 1878, Nos. 6—27.
		Zeitschrift, Band XIV, January, February, and March 1879.
		Zur Meteorologie der Alpengipfel.
		Bericht über die Beobachtungen auf hohen Bergen und in Luftballon.
		Sitzungsbericht d. Kais. Akad. Vienna, No. 1, 1879.
		Bericht über die Fortschritte der Geographischen Meteorologie.
„	K. K. Geologischen Reichs Anstalt.	Verhandlungen, Nos. 11—18 of 1877, with title page.
		Ditto, Nos. 1—10 of 1878.
„ ...	K. K. Centrale Austalt für Meteorologie u Erdmagnetismus.	Internationaler telegraphischer Wetterbericht, II Jahrgang, Nos. 1—365.
		Internationeler telegraphischer Wetterbericht, III Jahrgang, Nos. 1—63.
		Jahrbücher neue Folge, Band XII, Jahrgang 1875.

Presentations to the Library from the 1st April 1878 to the 31st March 1879—continued.

Place.	Donor.	Title of Work.
Washington ...	Chief Signal Office ...	Daily Bulletin of the Signal Service, U. S. A., with the synopses, probabilities, and facts, April to October 1874.
	"	Bulletin of International Observations, 24th May to 9th June, 11th June to 9th September, 11th to 26th September, 19th and 27th to 30th October, 1st November 1877 to 5th February 1878.
		Monthly Weather Review, January to June and August to October 1878.
		Reports of the Chief Signal Office, War Department, for 1877.
...	Smithsonian Institute ...	Smithsonian Report, 1876.
" ...	Naval Observatory, U. S. ...	Meteorological Observations for 1875.
Wellington ...	Observatory ...	Abstract of Meteorological Observations, New Zealand, from August 1877 to February 1878.
		Bulletin des Observations, December 1877, with title page.
Zi-ka-wei ...	Observatoire de Zi-ka-wei ...	Bulletin des Observations, January to November 1878.
"		Recherches sur les variations des vents à Zi-ka-wei d'apres les observations faites de 1873 á 1877.
Zurich	Swiss Meteorological Institute	Schweizerische Meteorologische Beobachtungen 1864—1875.
		Schweizerische Beobachtungen ; Meteorologische Supplement Band ; Erste Zweite und Dritte Lieferung.

Purchases for the Library.

Annalen der Physik und Chemie, Nos. 2—12, 1878, and Nos. 1 and 2, 1879.
Philosophical Magazine, Vol. V, Nos. 30—33; Vol. VI, Nos. 34—39; Vol. VII, Nos. 40—41.
American Journal of Science and Arts, Vol. XV, Nos. 87—90; Vol. XVI, Nos. 91—96.
Comptes Rendus de l'Académie des Sciences, Vol. LXXVI, Nos. 9—25; Vol. LXXVII, Nos. 1—16 and 18—27; Vol. LXXVIII, Nos. 1—8, and index for Vols. LXXV and LXXVI.
Nature, Nos. 437—488. Index and title page for Vol. XVIII.
Hoffmeyer's Charts, October and November 1875.
Report of the British Association for 1877 and 1878.
Symons' Monthly Meteorological Magazine, Vols. I—IX.
Dr. Crelle's Rechnentafeln.
Ansart's Essai Sur la Mécanique des vents et des courants.
Manual of the South Arcot District.
Manual of the Cuddapah District.

SIMLA,
October 13th 1879.

H. F. BLANFORD,
Meteorological Reporter to the Govt. of India.

APPENDIX A.

Extracts from Mr. J. Eliot's Report on the Administration of the Meteorological Department in Bengal and Assam, &c.

Second Class Stations.—At these stations, with the exception of Saugor Island, three observations are taken daily, *viz.*, at 10 A.M., 4 P.M., and at 7-35 A.M., Washington mean time. Hourly observations are recorded during four days of the month, on the 7th, 14th, 21st, and 28th. At Saugor Island, a very important station in connection with the storm-warning service for the protection of the port of Calcutta, four observations are taken daily.

There were seven second class stations during the year 1878-79. Of these, five are in Bengal and two in Assam. The names of the stations, of their Superintendents and Observers, together with the allowances they receive, are given in the following tabular statement :—

Second Class Stations.

Stations.	Superintendent.	Superintendent's allowance.	Observers.	Observer's allowance.	Assistant Observers.	Assistant Observer's allowance.
		Rs.		Rs.		Rs.
Sibsagar ...	Dr. M. Mookerjee ..	30	Baboo Dandadhar Datta	30	Assistant Observer ...	10
Goalpara ...	W. J. Mountain [1] ... / J. Slane [2] ...	30	Moniruddin Ahmed ...	30	Baboo Haromohun Dass [14] / Kadimuddin [15] ...	10
Patna	Ballai Chunder Sen [3] ...	30	Moonshee Mohabut Lal	35	Assistant Observer ...	10
Hazaribagh ...	E. A. Birch [5] ... / R. Bird, M.D. [4] ... / E. G. McDonnell [6] ... / J. J. Wood [7] ...	30	Rahim-oollah [8] ... / Tajrung Sahoy [9] ...	30	Enayet Hussein [16] ... / Ruheem-oollah [17] ... / Tajrung Sahoy [18] ... / Faiuz Khan [19] ...	10
Chittagong ...	.....	...	Mr. J. Burke [10] ... / „ J. M. Bennett [11] ...	32	Mr. E. Texeira [20] ... / „ W. Wootten [21] ... / „ E. Ballantye [22] ... / „ G. Convill [23] ...	13
Saugor Island ...	.....	...	„ R. H. Peters [12] ... / „ W. C. Ghosh [13] ...	45		
Cuttack ...	.....	...	„ J. C. Smith ...	32	„ W. Simpson [24] ... / „ G. S. Adshead [25] ...	13

[1] To 18th September 1878.
[2] Since 19th September 1878.
[3] To 3rd April 1878.
[4] Since 4th April 1878.
[5] To 8th June 1878.
[6] 9th to 11th June 1878.
[7] Since 12th June 1878.
[8] To 14th March 1879.
[9] Since 15th March 1879.
[10] To 14th December 1878.
[11] Since 15th December 1878.
[12] To 15th April, 19th May to 13th November 1878, 23rd November to 2nd February 1879, and since 24th February 1879.
[13] 16th April to 18th May 1878, 14th to 22nd November 1878, and 3rd to 23rd February 1879.
[14] To 30th November 1878.
[15] Since 1st January 1879.
[16] To 31st August 1878.
[17] 1st September to 31st October 1878.
[18] 1st November 1878 to 14th March 1879.
[19] Since 15th March 1879.
[20] To 24th June 1878.
[21] 25th June to 31st October 1878.
[22] 1st November to 31st December 1878.
[23] Since January 1879.
[24] To 20th April, 21st to 28th June 1878.
[25] 21st April to 20th June 1878, and since 29th June 1878.

As the Telegraph Office at Chittagong has been removed to a new site, it was necessary to remove the observatory which is attached to the Telegraph Office. This has been done, so far as was possible, in such a way as to make the future observations comparable with previous observations at the same station. A Beckley's anemograph is also being erected at that station. This will give a continuous record of the wind direction and velocity. A new shed is being constructed at Saugor Island, and a few slight changes made in its position and the position of the anemometer, to enable the observer to take observations during stormy weather with the least amount of personal inconvenience. A Beckley's anemograph is also being erected at this station, and will, it is hoped, be in working order in a few months. It has also been found necessary to make certain changes in the position of the shed at Hazaribagh. According to previous arrangements, the shed for the thermometers, &c., was at some distance outside the jail walls, whilst the barometer was in one part of the building, and the

anemometer on one of the most distant towers of the jail wall. This wide distribution of the instruments was attended with several disadvantages. The observer's house has hitherto been so situated as to reduce these disadvantages to a minimum. Unfortunately, in order to effect certain improvements, it was necessary (March 1879) to pull down the observer's house and remove him to more distant quarters. In order to enable the work of observation (more especially the hourly observations) to be carried on effectively under the new conditions, it has become necessary to remove the shed and all the instruments to another and more open and favourable site. It has also been decided to erect a Casella's anemograph at this station; so that the character of the meteorological work at Hazaribagh, which has hitherto been very high, will be considerably improved by these changes. The only second class station which has given any trouble during the year has been Goalpara. On the night of the 2nd December 1878 the following instruments were stolen from the observatory:—

Barometer.	Wet minimum thermometer.
Sun thermometer.	Lantern.
Grass radiation thermometer.	Rain-gauge receiver.
Glass cup.	

New instruments were sent as speedily as possible to replace the stolen ones. They did not arrive until the 27th January, so that a hiatus of nearly seven weeks occurs in the Goalpara observations for the year. Suspicion pointed to the assistant observer (more especially as there had been for some time much jealousy and bad feeling between the chief observer and him). He was tried for theft, but acquitted on the ground of insufficient evidence. The circumstances connected with it were, however, so suspicious, as to make it undesirable to re-employ him, and another assistant observer has been selected. The work of observation at Goalpara again appears to be carried on satisfactorily.

Third Class Stations.—At these stations, observations are registered at 10 A.M. and 4 P.M. The stations are twelve in number—the same as during the previous year—of which ten are in Bengal, one (Akyab) in British Burmah, and one (Silchar) in Assam. The names of the third class stations, with their Superintendents and observers, are given in the following tabular statement:—

Third Class Stations.

Stations.	Superintendents.	Observers.	Observer's allowance.
			Rs.
Darjeeling ...	.....	Mr. M. J. Blong	25
Purneah ...	Dr. D. Picachy ...	Baboo Komode Behary Samanto [12]	
		„ Heera Lall Mookerjee [13] ...	15
Durbhunga ...	„ J. McDonnell, M.D.[1] ...		
	Baboo Rajkissen Mookerjee [2] ...		
	Dr. A. E. R. Stephens [3] ...	Jessoree Prosad.	
	„ E. Bovill, F.R.C.S.[4] ...		
Gya	„ W. F. Murray [5] ...		
	„ J. W. Mullen [6] ...	Nourungee Lall	15
Berhampore ...	„ S. M. Shircore ...	Baboo Mahendra Nath Roy ...	15
Burdwan ...	„ L. Cameron [7] ...		
	„ Dinobundhoo Dutt [8] ...	„ Mokhoda Prosad Chowdhry ...	15
	„ W. F. Murray [9] ...		
Jessore... ...	„ Gordon Price ...	„ Paresh Nath Roy Chowdhry ...	15
Dacca	.....	Mr. E. W. Shave	25
Silchar ...	„ G. A. Warburton [10] ...	Baboo Ramesh Chunder Bhadra ...	15
	„ R. N. Campbell [11] ...		
Demagiri ...	.....	„ Debendro Nath Guho [14]	
		„ Aushok Krishna Goho [15]	
False Point ...	.....	Mr. H. W. Alley	30
Akyab ...	....	„ F. J. Bennet [16]	30
		„ E. B. Atkinson [17]	

[1] To 12th July 1878.
[2] 13th July to 25th August 1878 and 21st October to 26th November 1878.
[3] 26th August to 20th October 1878.
[4] Since 27th November 1878.
[5] To 22nd December 1878.
[6] Since 23rd December 1878.
[7] To 12th November 1878.
[8] 13th November to 31st December 1878.
[9] Since 1st January 1879.
[10] To 23rd March 1879.
[11] Since 24th March 1879.
[12] 1st to 14th April, and since 15th July 1878.
[13] 15th April to 14th July 1878.
[14] To 1st October 1878, and since 2nd January 1879.
[15] 2nd October 1878 to 1st January 1879.
[16] 1st April to 24th September 1878, and 16th October 1878 to 22nd March 1879.
[17] 25th September to 15th October 1878 and since 23rd March 1879.

The majority of these stations are in satisfactory working order. Occasionally, however, the observers lapse into a state of carelessness, and erroneous observations are recorded, due either to careless reading, or to an indifference to time, which is discreditable to the observer. Burdwan, Dacca, and False Point, are by far the most satisfactory of the third class stations. At Akyab, the Telegraph Master, who is also the observer, has on several occasions delayed the transmission of the "precedence" telegrams to Calcutta, for the storm-warning service, until 4 or 5 P.M.

Occasional discrepancies appear to be shown by the comparison of the Gya and Durbhunga returns, and it is to be feared these too often represent carelessness on the part of the observers.

The character of the Purneah observations appears to me to have improved considerably during the past year.

Silchar was visited by Mr. Pedler during the month of December 1878. The account of his inspection will be found in another paragraph.

My experience continues to add to my conviction of the necessity of frequent visits to the meteorological observatories. Carelessness on the part of the observer is at once shown by the shed falling out of order and the instruments being neglected. And doubtful observations are, for all the more valuable purposes of meteorology, not merely valueless—they may, if allowed to have any weight whatever, be misleading. Hence inspection of the observatories must necessarily form one of the most important duties of the local Reporters.

Fourth Class Stations.—These only record the daily rainfall, the returns of which are forwarded weekly to the Central Office. At present rainfall registration is carried on at 162 revenue stations in Bengal and 4 in Assam.

Inspection of Observatories.

Four observatories were inspected during the year—Dacca and Cachar by Mr. Pedler, and Jessore and Hazaribagh by myself. The following is Mr. Pedler's report of the condition of the Dacca and Cachar observatories :—

At Dacca all the thermometers were in good order, but the scale of the minimum was rather indistinct from the black pigment having been rubbed out. The thermometer shed requires repairs, as the white-ants are eating away the posts; the thatching is also somewhat out of repair. Barometer in good order, but hung slightly low for an average European. The rain-gauge should have a low fence round it at a little distance, as cows, dogs, &c., are kept in the compound. Windvane is in bad position, being sheltered by the bath-room staircase from S.E. winds. Anemometer was working with much friction, as there was no oil on the bearings, and the cogwheels were dirty.

The Cachar Observatory was in thoroughly bad order, and appears to have been in this state since its establishment.

The eaves of the thermometer shed were about 6 feet 4 inches above the ground, and the east and west sides of the shed were enclosed with mat walls. The fence round the radiation thermometers was too high by a foot. The fence round the rain-gauge was at least 18 inches too high. The whole observatory requires to be surrounded by a fence.

The maximum thermometer was not acting as a maximum, but as an ordinary dry-bulb. The grass radiation thermometer had been broken a short time previous to my arrival. The other thermometers were in good order.

The barometer was in a separate shed, which was fairly protected from the sun by a row of high plantain trees; there is no *pucca* building near, in which it could be placed. In fact, there are very few *pucca* buildings in the whole station of Silchar. The barometer was in good order, and was suspended to the centre-post of the shed.

The windvane was erected considerably out of the perpendicular, and the north point was directed (as nearly as could be ascertained by a small compass) to the N.N.E. As, however, the post was quite rotten, and it was unsafe to ascend the ladder, it was difficult to obtain an accurate measurement. A new post and windvane must be supplied, as the present one is much bent and worn. The old vane was put up by the present observer on 14th May 1876.

The anemometer was one with five wheels, but out of the five only two (the miles and tenths of miles of the wheels) had index pins. It was also old and much worn, and a new one must be sent. The observer was in the habit of reading tenths of miles as miles, which accounts for the extraordinary daily weather telegrams he was in the habit of sending. The anemometer, too, was not perpendicular, but bent to the south-east.

The Observatory is situated near the house of the Civil Surgeon, and on the top of rising ground, the highest in the neighbourhood. There are no high trees near, nor are there many houses, only some native huts and soldiers' lines of huts. The exposure of the instruments is very good, and being near the Civil Surgeon's house, it *should* be well looked after.

The Baboo keeps his books and correspondence, &c., very neatly, and is an intelligent man. I gave him two days' drilling in his work.

The Observatory at Silchar will, I fancy, always be an expensive one to keep up in the matter, of repairs, for the thatching of houses in the station is changed yearly, and bamboo work requires to be renewed every 18 months.

The Jessore Observatory is situated within the jail walls, and consequently the exposure of the instruments is not so open as might be desired. The observatory itself was in good condition, and the instruments in order. The observer was trained at Alipore, and is thoroughly acquainted with the work of observation. This observatory is now in a more satisfactory condition than last year. I have found it necessary to give the present observer warning to take the observations strictly at the appointed hours of observation.

It was necessary to visit Hazaribagh to select a site for the observatory in a more convenient position than at present. The observatory itself I found in excellent order. The observer is one of the most careful and trustworthy in Bengal, and consequently the Hazaribagh observations are specially reliable and valuable.

Central Office.—The office establishment now consists of five clerks, instead of four as in previous years. The additional work thrown upon the office latterly, necessitated the employment of an additional clerk, to which Government gave its sanction in May 1878. The office continues under the charge of the head-clerk to the Meteorological Reporter to the Government of India, and has, as in previous years, worked satisfactorily. With the gradual extension of meteorological work and the increased number of enquiries for meteorological information from the Irrigation, Public Works, Medical, and other departments, it is very difficult to prevent the ordinary office work falling into arrears, and some further slight increase of establishment is very desirable.

Daily weather reports.—These reports, published in connection with the Calcutta storm-warning signal service, are based upon observations taken at a series of selected stations round the Bay of Bengal. Daily telegrams were received during the greater part of the year from 10 stations, viz., Alipore, Saugor Island, Cuttack, False Point, Vizagapatam, Madras, Colombo, Chittagong, Akyab, and Diamond Island. Weather telegrams from Cuttack were discontinued during the year, as they were judged to be unnecessary. False Point supplies all the information required from the Orissa coast.

In order to show the degree of despatch attained during the past year by the various stations which contribute to the service, and to compare it with that obtained in former years, two months—

February and August—have been selected, and the number of telegrams received on the day of observation, and one, two or three days after, are given in the following table:—

Reports issued for publication.

Stations.	On day of observation.						One day after.						Two days after.						Three days after.						More than three days.					
	February.			August.			February.			August.			February.			August.			February.			August.			February.			August.		
	1876.	1877.	1878.	1876.	1877.	1878.	1876.	1877.	1878.	1876.	1877.	1878.	1876.	1877.	1878.	1876.	1877.	1878.	1876.	1877.	1878.	1876.	1877.	1878.	1876.	1877.	1878.	1876.	1877.	1878.
Saugor Island...	57	55	52	62	61	58	1	1	4	...	1	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..
Chittagong ...	...	25	28	2	31	29	58	29	...	56	..	2	...	4	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	
Akyab ...	...	25	23	...	28	22	58	23	3	58	1	9	...	4	2	2	...	...	...	...	...	2	...	...	...	...	...	...	...	.
Diamond Island	...	...	22	...	...	...	...	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.
Cuttack ...	25	26	28	27	31	...	28	28	...	31	...	...	5	2	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...
False Point ...	...	...	28	...	...	31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.
Vizagapatam ...	...	...	28	...	31	31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Madras ..	...	..	...	...	...	...	25	24	22	26	27	...	30	28	24	32	30	...	5	4	3	6	4	...	...	...	4	...	...	
Colombo ...	...	...	24	...	31	31	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

The service is not altogether satisfactory. The telegrams are, by the orders of Government, strictly "precedence." Several of the stations, more notably Chittagong and Akyab, have notwithstanding been very dilatory in the transmission of telegrams. This is the more inexcusable in these two cases, as the Telegraph Masters are also the observers. In several instances, the 10 A.M. observations at Akyab were not telegraphed until 5 P.M.

The adoption of a telegraphic code, drawn up by Mr. Pedler and myself, has very considerably diminished the cost of this service.

The protection of the port of Calcutta by the early issue of storm signals is one of the most important duties of the Bengal Meteorological Office, and as the present service appears to me to be neither rapid enough, nor based on sufficient information, proposals for its improvement will be submitted to the Bengal Government at a very early date.

Storm signals.—These were hoisted once during the year, on the 5th of November, during the prevalence of a small cyclone in the centre of the Bay of Bengal. There were a number of cyclonic disturbances originating in the Bay during the rains, the majority of which advanced into the interior across the Orissa or Balasore coast. The termination of the rains was also marked by a remarkable series of cyclonic disturbances, at least four in number, originating probably in the centre of the Bay to the north of the Andamans, and proceeding nearly due west to the Vizagapatam coast. They were of no large diameter, and hence hardly affected the coast of Bengal.

Special reports.—During the year, the only special report of any importance was one on the rainfall of Bengal, prepared by Mr. Pedler, for the information of the Famine Commission.

APPENDIX B.I.

Extracts from Mr. S. A. Hill's Report on the administration of the Meteorological Department in the North-Western Provinces and Oudh.

Number and classification of observatories.

No change has been made during the past year, either in the number of the observatories reporting to my office, or in the methods and hours of observation. The number of observatories directly under the Meteorological Department is twelve; and two others, under independent management, send in weekly or monthly registers.

These are the Dehra Dún Observatory, under the Survey of India, and the observatory at Meerut, maintained by the municipality.

The fourteen observatories are divided into four of the second class and ten of the third. At the latter, barometric and thermometric observations are taken twice daily, at 10 A.M. and 4 P.M., and the rain-gauge is read at 6 P.M. At the second class observatories, an observation at 7h. 35m. A.M., Washington mean time, is taken daily, in connection with the international synoptic observations, organized by General Myer, of the United States Signal Service, and hourly observations are taken four days each month in addition. Table I in the Appendix shows the classification of the observatories, and the names of the superintendents and observers who have acted during the year.

Allahabad Observatory.

The Allahabad Observatory has continued to work as one of the second class, two additional observations being taken, however, at 10 P.M. and 4 A.M. each day. The self-registering meteorograph has not yet been received from Europe; and up to the present time there has been no place provided, in which it may be put when it arrives. The local Government has recently been applied to, for permission to use an unoccupied wing of the Thornhill Memorial building, in the Alfred Park, for the accommodation of the Meteorological Office and observatory; and it is hoped that, by the time the meteorograph arrives, arrangements will have been made to enable it to be brought into use immediately.

Instruments.

All the instruments in use during the year have had their errors carefully determined by comparison with standards in Calcutta, and the proper corrections have been applied to all their readings. In a climate so subject to extremes of temperature and humidity as that of the North-Western Provinces, it is to be feared that the index errors of barometers are liable to change, and frequent comparison with portable standards is therefore desirable. On my tours of inspection, I have not been able to make these comparisons, for want of a travelling barometer; but in November, Mr. Eliot, who was officiating as Meteorological Reporter to Government of India, compared the barometers at Allahabad and Agra with two portable standards brought from Calcutta, and found in each case an unexplained error of a few thousandths of an inch. Next year, I propose to carry one or two barometers with me, and compare them with the barometer in use at each station I visit. All the barometers, except those at Dehra and Ajmere, have been kept inside buildings throughout the year; but at these two places the barometer was exposed in the shed along with the thermometers.

Many breakages have occurred among the exposed radiation thermometers during the year; and at one station, Bareilly, they have been stolen several times. It is doubtful whether any results worth the trouble and expense of keeping up these instruments will ever be obtained from the observations made at the third class stations; and in future their use might be restricted to observatories of the second class. The nocturnal radiation thermometer is constantly getting out of order, and many of the observers seem unable to set it right again. The usual routine in such case is to write detailed instructions regarding the method of adjusting the instrument, and then to find, after a correspondence lasting a week or two, that it is returned to Allahabad as useless. After being put to rights, the thermometer is again issued to the station, and, owing to the shaking it undergoes on the journey, it arrives in a worse condition than at first. The correspondence then begins again. The solar radiation thermometers are also liable to get out of order, especially those constructed on Phillips' principle. These lose their air-speck and cease to be self-registering. At a few stations, the old methods of exposure of these instruments, which had been retained for the purpose of preserving the continuity of the observations, gave way at the beginning of January 1879 to the new method introduced at the other stations a year or two ago. This consists in placing the thermometer on a stand 4 feet above the ground. The solar thermometers at all the stations (except Dehra) will be thus exposed in future.

Anemometers recording the daily velocity of the wind have been used throughout the year at every station except three. At Gorakhpur, an instrument of this kind had been lying in store for some time, but no place on which to mount it was prepared until about a month ago. It is now erected

on a small pillar on one corner of the dispensary building to which the observatory is attached, and its readings have been taken since the beginning of the present month. The position of the instrument is such as to afford a good exposure all round. The anemometers formerly in use at Agra and Jhansi were returned to the head office for repairs. Owing to the small supply of these instruments in store at Calcutta, no others could be sent to take the place of those returned, for a long time; but, recently, a new two-wheel anemometer has been sent to Jhansi, and a self-registering anemograph by Casella will be put up at Agra immediately. During the present year, therefore, each observatory will be fully furnished with instruments.

Inspection of observatories.

Seven observatories were inspected during the year, namely, Lucknow, Bareilly, Ranikhet, Agra Ajmere, Benares, and Sutna. The first three were visited in June; Agra and Ajmere in October; and Benares and Sutna in July and November respectively. At all the stations, except Ajmere, I found the conditions of the observatory buildings and of most of the instruments generally satisfactory. The only fault to be found with the instruments at Bareilly was that the post on which the wind-vane is mounted was a little out of the vertical. This was at once rectified. The observatory sheds had all been repaired during the year; and one of them, at Benares, where the old shed was blown down by a storm in May, was entirely re-constructed. The observer's house at Ranikhet, in which the barometer is kept, had been recently re-roofed, and was in very good order. The rain-gauge at this station had been removed to a better position; and all the instruments were in good condition, except the anemometer, which wanted cleaning, and worked with far too much friction. It has been replaced by a new instrument.

The Beckley anemograph, erected at Lucknow in April 1878, has been very unfortunate. When I passed through Lucknow in May, I found that, though it was working apparently very well, the registering apparatus had been put up with the wrong side foremost, so that the velocity pencil was tracing on the part of the paper ruled for direction, and the direction pencil on that ruled for velocity. On my return from Ranikhet in June, this part of the instrument had been adjusted properly, but the external part (in which a spindle driven by the vanes works inside a hollow shaft attached to the direction pointer) had got blocked, owing to dust and expansion by heat, and would not work freely. From the 8th of July to the middle of November the instrument is said to have worked regularly, but the traces for August, September, and October are missing. They are supposed to have been lost in transmission by post from Lucknow to Allahabad. In November, the clock ceased to go, and had to be taken down to be cleaned. The instrument only commenced to work again at the middle of January, and since then the traces have been regularly received. The records of the instrument for the past year are thus of a very fragmentary character. This experience shows that it will be inadvisable in future to erect such costly and troublesome instruments at stations where there is no trained scientific officer to superintend their working.

The condition of the Ajmere Observatory I found to be very unsatisfactory. The observatory has been in existence since 1866, and has always been attached to the jail. The barometer was outside in the observatory shed when I visited Ajmere, although my predecessor, Mr. Eliot, three years ago, had himself removed it to the inside of the jail office. The shed was in a shaky condition, and afforded a very inadequate protection to the thermometers, upon some of which the morning sun was shining at the time of my visit. Instead of re-constructing the building on its present site, I proposed, at the suggestion of Major St. John, R.E., to remove it to the grounds of the Mayo College; a situation much more open, and in every way more suitable. There was one difficulty about this, however, namely, that the college is closed for three months every year; and that, during the vacation, there would be nobody to act as Superintendent, unless the former Superintendent, Dr. Murray, would continue to do so. This Dr. Murray could not do, as the college was at a long distance from his house. In consequence, the observatory remains in its old position at the jail. Some new arrangements should be made at Ajmere, or else a suggestion made by the Meteorological Reporter for Bombay, that the observatory be transferred from Ajmere to Nasirabad, should be adopted.

Character of the observations.

On the whole, the character of the observations has improved during the year. Those stations from which good returns were received in previous years have maintained their character, while the others have improved, until all the observations now appear to be taken with nearly the same degree of care and exactness. The only ones to which a suspicion of dishonesty sometimes attaches are the hourly observations at Roorkee. The doubtful figures are those recorded in the early morning hours, when, it is to be feared, the observer sometimes goes to sleep. The weekly or monthly returns of observations have been received punctually from every station except Lucknow; where, at one time, the observer allowed these returns to fall six weeks in arrears. On being reprimanded, however, he recovered the lost time, and for the last two months has sent in the registers either on, or a day or two after, the prescribed dates.

Office and office work.

The number of clerks in my office has not been increased during the year, and the remarks made in my report of last year, regarding the insufficiency of the present staff, apply with still greater force this year. Little but the primary reductions of the observations and the preparation of the monthly registers has been accomplished, and yet the work remains more than a month behindhand. Many special investigations, such as the determination of the co-efficients of the diurnal variations of pressure, temperature and humidity at the second class stations, the reduction and tabulation of the anemograph traces taken at Lucknow, &c., ought to be undertaken; but without another computer this is impossible. An application to Government to sanction the appointment of another computer has recently been made, but the result is not yet known. Copies of the monthly registers for 1878 have been sent, as soon as ready, to the head office in Calcutta, the last being despatched on the 26th February 1879.

The following meteorological statements have been published as usual during the year:—

1. Records of the observations taken at Allahabad four times each day, published in the local daily paper, the *Pioneer*.
2. Weekly returns of rainfall in the North-Western Provinces and Oudh, published in the *Government Gazette*.
3. Monthly meteorological abstracts from fourteen observatories, with a short discussion of the observations for each month, published in the *Government Gazette*.
4. Annual statement of rainfall in the North-Western Provinces and Oudh for the year 1878, published in the *Government Gazette* of the 1st February 1879.

In addition to these, a paper on *Variations of Rainfall in Northern India* has been prepared for publication in the third part of the *Meteorological Memoirs*. In the early part of the rainy season of 1878, a good deal of additional work was thrown upon the office, in the preparation of replies to certain questions issued by the Famine Commission, and in drawing up a table, comparing the rainfall of 235 stations, from the 1st June to the 15th August 1878, with the averages for the same period. To assist in preparing these returns, an additional clerk was employed for three and a half months, with the sanction of the local Government, and paid out of Provincial funds.

All the old rainfall records of the provinces have now been worked up, and a report on the normal distribution of rain in the North-Western Provinces and Oudh is in course of preparation. When finished, it will greatly facilitate the reply of such questions as those of the Famine Commission.

Library.

The additions to the library during the year have not been numerous. A list will be found in the Appendix, Table III. There being no funds at the disposal of the office for the purchase of books and periodicals, the additions consist chiefly of reports, &c., presented or interchanged by other offices, and of a few spare copies received from the head office in Calcutta.

APPENDIX B.II.

Names of the Observers and Superintendents of the several Observatories in the N. W. Provinces and Oudh during the year 1878-79.

Class.	Observatory.	Observer.	Superintendent.	Remarks.
Second Class.	Allahabad	Kedar Nath Chatterjee, with an assistant.	S. A. Hill, Esq.	
	Agra	Mir Altaf Ali, with an assistant.	Dr. A. H. Hilson	
	Lucknow	Chotay Lal, with an assistant.	„ J. C. Whishaw.*	* Dr. Franklin officiated during September and October 1878.
	Roorkee	Chiranji Lal, with an assistant.	„ Murray Thomson†	† Captain A. Cunningham, Major A. M. Brandreth, and Lieutenant S. M. Maycock officiated at intervals.
Third Class.	Chakráta	Saligram	Major Blair, R.E. Colonel J. M. Dawson.	
	Ránikhet	Jeswanand‡	No Superintendent.	‡ Gungadutt officiated from middle of September to end of October 1878.
	Dehra	.....	.....	
	Meerut	Harsaran Dass ...	Dr. W. Moir.	
	Bareilly	Jwala Parshad ...	E. A. Phillips, Esq.	
	Gorakhpore ...	Kali Basant Suty Sheolochun.	Dr. C. Prentis.	
	Benares	Devakinandan Pathak ...	A. E. Gough, Esq. J. C. Nesfield, Esq.	
	Jhánsi	Kalka Das	Dr. H. J. Linton and Dr. R. Tate.	
	Ajmere	Ramparshad	Dr. T. Murray.	
	... ...	Harnath	„ S. J. Goldsmith.	

APPENDIX C.I.

Extract from Dr. A. Neil's Report on the administration of the Meteorological Department in the Punjab.

Besides the management of the observatory here, the working of which has, I think, been most satisfactory, we have forwarded in a revised form all the observations received from the several observatories.

My office work is very great. I have already addressed you upon this subject, with the view of obtaining an increase of salary to one of the clerks. If this is not granted, he will, I fear, leave me, and I cannot afford to lose him.

In addition to our former routine work, you know that on the 15th June last year, a system of telegraphing observations from five stations in the province was established and is still continued. We receive, by order from this office, copies of these from the other stations besides ours, and attest their accuracy.

No observatory has been suppressed during the year. The observatory at Ludianah was removed from the police hospital to the jail on the 5th of May.

The following observatories have been inspected :—Simla, Ludianah, Sialkot, and Multan[1]. These were found in fair working order, and I have little or no complaint to make.

Some time ago I was addressed by the Deputy Quartermaster General on the subject of the observatory at Simla. The object was to obtain an allowance equivalent to that which is given to each of our observatories in the Punjab. I replied that I would certainly recommend the application for your favorable consideration, but on the proviso only that the observer complied strictly with the rules which are in force in the other observatories.

[1] Rawalpindi and Delhi were besides inspected by Mr. Eliot.

As this involved observations on Sundays and *other* holidays, I have heard nothing further in reference to the application.

By order of Government, I prepared a synopsis of the rainfall and weather phenomena of the province for the information of the Famine Committee. This entailed considerable labour and pains; but I trust it will be found useful to the Committee.

I have also in preparation a more complete synopsis of the climate of the Punjab, and hope to have it ready for the press shortly.

I beg to append a list of the observatories, with the names of the observers, for your information

APPENDIX C.II.

List of the Observatories in the Province of Punjab, with the names of the Observers and Superintendents.

Stations.	Superintendents.	Observers.	Allowance.	Remarks.
			Rs.	
1. Lahore	Dr. A. Neil	Jasput Rai	30	Throughout the year.
2. Peshawar	„ Courtney (*a*)	Divan Chand, Assistant ...	10	
	„ McDonald (*b*)	Kashi Ram (*e*)	15	(*a*) Up to 5th February, (*b*) 11th February; (*c*) 19th February 1879; (*d*) 31st March 1879; (*e*) up to 9th January 1879; (*f*) up to 30th January 1879; and again (*e*) took charge on the 31st January 1879.
	„ J. Moror (*c*)	Abdool Jabar (*f*).		
	„ A. Taylor (*d*).			
3. Rawalpindi	Dr. Henderson	Bhawani Doss	15	Throughout.
4. Murree	Revd. G. C. Peak	Mr. R. Johnson	15	Throughout.
5. Dehli	Dr. J. Fairweather (*a*) ...	Ramkishen (*c*)	15	(*a*) 1st April to 31st August; (*b*) to 31st March 1879.
	„ W. Coates (*b*)	Radhakishen (*d*)	...	(*c*) April to June 1878; (*d*) up to 31st March 1879.
6. Sialkot	„ Cunningham (*a*)... ...	Fatheh Singh	15	(*a*) Up to 27th September 1878; (*b*) up to 5th March 1879.
	„ A. J. Dale (*b*).			
7. Ludianah	Dr. R. Rouse	Ameer Beg (*a*)	15	(*a*) April; (*b*) 5th May to 11th December 1878; (*c*) to 31st March 1879.
		Gokal Chand (*b*).		
		Duni Chand (*c*).		
8. Multan	Dr. J. C. Penny	Vahid Ally	15	Throughout the year.
9. Dera Ismail Khan ...	„ G. M. Davis (*a*) ...	Noor Buksh	15	(*a*) April to June 1878; (*b*) July to September 1878; again (*a*) to 31st March 1879.
	„ A. Macgreogor (*b*).			
10. Sirsa	„ J. Rehill.			
11. Ladakh	Joint British Commissioner ...	Fazalor Rohman	15	Throughout the year.
		Charag Din	20	
		Bhola Nath, Assistant ...	15	Throughout the year.
12. Simla	Major H. Collet, Asst. Qr. Mr. (*a*)	J. Moorhead (*c*)	...	(*a*) and (*c*) from 1st April to 5th November 1878; (*b*) and (*d*) up to 31st March 1879.
	Captain M. J. King Harman, Depy Asst. Qr. Mr. Genl. (*b*) ...	L. G. Pepperell (*d*)	Not known	

LAHORE,
Dated 3th April 1879

A. NEIL, M.D.,
Meteorological Reporter for Punjab.

APPENDIX D.

Return showing the names of the Superintendents and Observers at the several Observatories of the Central Provinces, during the year 1878-79.

Observatory.	Superintendent.	From	To	Observer.	From	To	Remarks.
Nagpur	Surgeon-Major J. F. Barter ...	1st April 1878 ...	31st Oct. 1878 ...	T. V. Vardharajooloo	1st April 1878 ...	31st Mar. 1879.	
	Captain F. B. Morris	1st Nov. ,, ...	29th Dec. ,, ...	T. V. Allagheriswamy (Assistant)...	1st ,, ,, ...	28th Feb. ,,	
	Hospital Assistant T. V. Vardharajooloo	30th Dec. ,, ...	28th Feb. 1879.				
	Surgeon H. M. Leckler	1st Mar. 1879 ...	31st Mar. ,, ...	P. Soobiah (Assistant)	1st Mar. 1879 ...	31st Mar. ,,	
Jubbulpore ...	Dr. Rice, M.D.	1st Jan. 1878 ...	6th April 1878 ...	Prasanoo Coomar Bose ...	1st Jan. 1878 ...	16th Sept. 1878.	
	,, J. Brake, M.D.	7th April ,, ...	23rd Dec. ,, ...	Madhorao	17th Sept. ,, ...	5th Mar. 1879.	
	,, J. Browne, M.D.	24th Dec. ,, ...	31st Mar. 1879 ...	T. V. Allagheriswamy	6th Mar. 1879 ...	31st ,, ,,	
				Ameeruth Hoosain (Assistant) ...	1st Jan. 1878 ...	31st Jan. 1878.	
				Kureemoodeen (ditto) ...	1st Feb. ,, ...	2nd Sept. ,,	
				Koonj Behari Lal (ditto) ...	3rd Sept. ,, ...	13th Mar. 1879.	
				Zymool Abdeen (ditto) ...	14th Mar. 1879 ...	31st ,, ,,	
Pachmarhi ...	Captain F. B. Morris	1st April ,, ...	23rd Oct. 1878 ...	Pandit Madhorao	1st April 1878 ...	14th Sept. 1878.	
	Lewis Gordon, Esq.	24th Oct. ,, ...	31st Mar. 1879 ...	Baboo Prasanoo Coomar Bose ...	20th Sept. ,, ...	31st Mar. 1879.	
				Pandit Narain Bhagwant (Assistant)	1st April ,, ...	31st ,, ,,	
Saugor	Dr. D. F. Bateman	1st April ,, ...	31st ,, ,, ...	Deendyal Pathuck	1st ,, ,, ...	7th May 1878.	
				Nund Kishore	8th May ,, ...	31st Oct. ,,	
				Deendyal Pathuck	1st Nov. ,, ...	31st Mar. 1879.	
Hoshaggabad ...	Surgeon H. M. Leckler	1st April ,, ...	17th Feb. ,, ...	Vasudeva Pershad	1st April ,, ...	9th April 1878.	
	Kunja Lal Sanyal	8th Feb. 1879 ...	31st Mar. ,, ...	Jadu Nath	10th ,, ,, ...	23rd ,, ,,	
				Kalika Pershad	24th ,, ,, ...	31st Mar. 1879.	
Khandwa	Dr. P. Cullen	1st April 1878 ...	19th Sept. 1878 ...	Rajaram Narain	1st ,, ,, ...	31st ,, ,,	
		21st Oct. ,, ...	31st Mar. 1879.				
	,, Mayne	20th Sept. ,, ...	20th Oct. 1878.				
Seoni	,, S. H. Browne, M.D.	1st April ,, ...	23rd ,, ,, ...	Punchum	1st ,, ,, ...	31st ,, ,,	
	,, W. E. Johnson, M.D.	24th Oct. ,, ...	31st Mar. 1879.				
Chanda	,, M. Craggs	1st April ,, ...	31st ,, ,, ...	Seetaram	1st ,, ,, ...	31st ,, ,,	
Raipur	Surgeon C. Lloyd	1st ,, ,, ...	4th June 1878 ...	Krishen Rao	1st ,, ,, ...	31st ,, ,,	
	Surgeon-Major J. B. Gaffney ...	1st June ,, ...	31st Mar. 1879.				
Sumbulpore ...	Dr. J. E. Harrison	1st April ,, ...	31st ,, ,, ...	Shamsoondur Dass	1st ,, ,, ...	31st ,, ,,	
Sironcha	Dr. J. B. Gaffney	1st ,, ,, ...	14th May 1878 ...	Mohun Lal	1st ,, ,, ...	11th May 1878.	
	P. Moothookrishna Naidu	15th May ,, ...	26th June ,, ...	P. Moothookrishna Naidu ...	12th May ,, ...	31st Mar. 1879.	
	Harran Chunder Dutt	27th June ,, ...	31st Mar. 1879.				

NAGPUR,
The 28th April 1879

W. MOBU DASHURATH, *Head Clerk,*
For *Sanitary Commissioner, Central Provinces.*

APPENDIX E.

Extracts from Mr. F. Chambers' Report on the Administration of the Meteorological Department in Western India.

In the last report I announced the completion of the work of establishing about twelve additional small meteorological observatories in various parts of Western India. Throughout the year 1878-79 these observatories, along with those previously established, have been maintained in almost full continuous operation, and the meteorology of this portion of the country is now probably as well observed as that of any other portion.

The meteorological stations and the names of the supervising officers and of the observers who have officiated during the year are given below :—

Names of the Superintendents and of the Observers at the Meteorological Observatories in Western India during the year 1878-79.

Observatory.	Class.	Officer in charge.	Date. From	Date. To	Observer.	Date. From	Date. To
Kurrachee ...	Second ...	Surgeon-Major A. R. Hudson ...	1st April 1878 ...	21st Dec. 1878 ...	Lance Corporal E. Cardwell ...	1st April 1878 ...	4th Dec. 1878.
		Surgeon J. Hayes ...	22nd Dec. ,, ...	27th ,, ,, ...	,, J. Ayling ...	5th Dec. ,, ...	31st March 1879.
		Surgeon-Major J. Mackay ...	28th ,, ,, ...	24th March 1879.			
		,, J. Grant ...	25th March 1879...	31st ,, ,,			
Deesa (new observatory)	,,	,, C. F. Richards ...	1st Nov. 1878...	31st ,, ,, ...	Private James Bruce ...	1st Nov. ,, ...	31st ,, ,,
,, (old ,,)		,, D. O'Donovan ...	1st April ,, ...	22nd Sept. 1878 ...	Ditto ...	1st April ,, ...	31st Oct. 1878.
		,, C. F. Richards ...	23rd Sept. ,, ...	31st March 1879 ...	Hospital Sergeant H. Metcalfe ...	1st Nov. ,, ...	31st March 1879.
		,, B. Burland ...	1st April ,, ...	30th Sept. 1878 ...	Private B. Devery ...	1st April ,, ...	3rd July 1878.
Poona ...	,,	,, J. W. Purefoy ...	1st Oct. ,, ...	14th Feb. 1879 ...	Lance Corporal J. Hackett ...	4th July ,, ...	30th Nov. ,,
		,, J. Land ...	20th March 1879...	31st March ,, ...	Hospital Sergeant E. Connolly ...	1st Dec. ,, ...	14th Feb. 1879.
		...			Private T. Harriott ...	20th March 1879 ...	31st March ,,
		,, B. F. Geraud ...	1st April 1878 ...	9th Dec. 1878 ...	Lance Corporal G. A. Newman ...	1st April 1878 ...	10th Nov. 1878.
Belgaum ...	,,	,, — Jobson ...	10th Dec. ,, ...	18th ,, ,, ...	Corporal W. J. Cranston ...	11th Nov. ,, ...	26th March 1879.
		,, N. H. Garde ...	19th ,, ,, ...	27th Feb. 1879.			
		,, D. Hughes ...	28th Feb. 1879 ...	20th March ,,			
		,, B. Burland ...	21st March ,, ...	28th ,, ,,			
		,, — Hudson ...	29th ,, ,, ...	31st ,, ,,			
Jacobabad ...	Third ...	Surgeon S. H. Banks ...	1st April 1878 ...	18th April 1878 ...	Hari Bhan ...	1st April ,, ...	31st March ,,
		M. L. Bartholomeuz ...	19th ,, ,, ...	31st March 1879.			
Bickaneer ...	,,	No Superintendent.			Ram Lal ...	1st ,, ,, ...	31st ,, ,,
Satara ...	,,	W. Strachen, Esq. ...	1st ,, ,, ...	31st ,, ,,	Kazi Ahmed ...	1st ,, ,, ...	31st ,, ,,
		Superintendent of Cotton Experiments					
Hyderabad (Sind) ...	,,	Surgeon-Major A. F. Preston ...	1st ,, ,, ...	31st ,, ,, ...	Corporal C. Randal ...	1st ,, ,, ...	27th Sept. 1878.
					Assistant Apothecary P. Barretto ...	28th Sept. ,, ...	8th Nov. ,,
					Hospl. Asst. Ramchundra Warung	9th Nov. ,, ...	16th ,, ,,
					Assistant Apothecary P. Barretto...	17th ,, ,, ...	18th March 1879.
					,, D. B. Fonseca	19th March 1879 ...	31st ,, ,,
		,, P. W. Cockell ...	1st ,, ,, ...	2nd Nov. 1878 ...	Narayen Mane ...	1st April 1878 ...	31st ,, ,,
Bhuj ...	,,	Lieutenant-Colonel C. F. Wilson ...	3rd Nov. ,, ...	23rd ,, ,,			
		Surgeon P. J. Damania ...	24th ,, ,, ...	15th Feb. 1879.			
		,, A. F. Sargent ...	16th Feb. 1879 ...	31st March ,,			
		Surgeon-Major A. Moffit ...	1st April ,, ...	30th Oct. 1878 ...	Joseph Briggs ...	1st ,, ,, ...	31st ,, ,,
Mount Abu ...	,,	,, D. O'Donovan ...	30th Oct. ,, ...	14th Nov. ,,			
		,, A. Moffit ...	15th Nov. ,, ...	31st March 1879.			
		,, H. Waghorn ...	1st April 1878 ...	15th April 1878 ...	T. Bachu ...	1st ,, ,, ...	7th April 1878.
Neemuch ...	,,	,, A. H. Anthonisz ...	16th ,, ,, ...	15th June ,, ...	Hospital Sergeant F. Burbridge ...	8th ,, ,, ...	27th ,, ,,
		Surgeon-Major H. Waghorn ...	16th June ,, ...	30th Sept. ,, ...	T. Bachu ...	28th ,, ,, ...	31st March 1879.
		No Superintendent ...	1st Oct. ,, ...	15th Jan. 1879.			
		Surgeon-Major H. Waghorn ...	16th Jan. 1879 ...	7th March ,,			
		,, R. H. Bolton ...	8th March ,, ...	31st ,, ,,			

Indore	...	Third	...	Dr. W. F. Keegan	...	...	1st April 1878	...	13th Nov. 1878	...	Ganpat Sing	...	...	1st April 1878	...	16th Oct. 1878.
Rajkot	...	,,	...	,, F. Beaumont	...	...	14th Nov. ,,	...	31st Mar. 1879	..	Bhagwantrão	...	..	17th Oct. ,,	...	31st Mar. 1879.
				Surgeon J. Parker	...	...	1st April ,,	...	14th June 1878	...	Sheik Dadu	...	...	1st April ,,	...	28th Feb. ,,
				,, A. Sargent	...	...	15th June ,,	...	5th July ,,	..	,, Latif	...	.	1st Mar. 1879	...	28th Mar. ,,
				,, K. S. Nariman	...	...	6th July ,,	...	19th ,, ,,	...	,, Dadu	...	...	29th ,, ,,	...	31st ,, ,,
				,, J. H. Keith	...	...	20th ,, ,,	...	30th Sept. ,,							
				,, R. H. Batty	...	...	1st Oct. ,,	...	12th Jan. 1879.							
				,, A. Sargent	...	...	13th Jan. 1879	...	30th ,, ,,							
				,, H. W. Boyd	...	...	31st ,, ,,	...	16th Feb. ,,							
				,, R. H Batty	...	...	17th Feb. ,,	...	20th Mar. ,,							
Surat	...	,,	...	,, H. W. Boyd	...	...	21st Mar. ,,	...	31st ,, ,,							
				Surgeon-Major G. F. H. Brown	...	...	1st April 1878	...	5th Dec. 1878	...	Balu Khandu	...	..	1st April 1878	...	31st ,, ,,
				,, C. Joyut	...	...	6th Dec. ,,	..	15th ,, ,,	...						
Akola	...	,,	...	Surgeon J. H. Keith	...	...	16th ,, ,,	...	31st Mar. 1879	...						
				Dr. Charles Little	...	...	1st April ,,	...	4th Dec. 1878	...	Samuel Gregory	..	...	1st ,, ,,	...	31st ,, ,,
Amraoti	...	,,	...	,, T. Hume	...	...	5th Dec. ,,	...	31st Mar. 1879	...						
				,, J. S. Howard	...	...	1st April ,,	...	23rd ,, ,,	...	Mahomed Buran	...	...	1st ,, ,,	...	5th April 1878.
				Apothecary G. E. Kind	...	...	24th Mar. 1879	...	31st ,, ,,	...	Sakharam Pandurang		...	6th ,, ,,	...	30th July ,,
											Mahomed Buran	..	...	31st July ,,	...	9th Aug. ,,
Chikalda	...	,,	...								Sakharam Pandurang		...	10th Aug. ,,	...	31st Mar. 1879.
Buldana	...	,,	...	No Superintendent.							Aminula Khan	..	...	1st April ,,	...	31st ,, ,,
Malegaon	...	,,	...	Dr. A. R. Menesse	...	...	1st April 1878	..	31st Mar. ,,	...	Pandurang Krishnáji	...	...	1st ,, ,,	...	31st ,, ,,
				Surgeon-Major W. D. Ticehurst	...	...	1st ,, ,,	...	4th May 1878	...	Bhágu Máhádu	...	...	1st ,, ,,	...	31st ,, ,,
				Surgeon B. M. Koyajee	...	...	5th May ,,	...	12th June ,,							
				Surgeon-Major S. B. Haliday	...	...	13th June ,,	...	7th Sept. ,,							
				,, H. P. Jervis	...	...	8th Sept. ,,	...	20th Nov. ,,							
				Apothecary T. Robinson	...	...	21st Nov. ,,	...	27th Feb. 1879.							
				Surgeon B. N. Koyajee	...	...	28th Feb. 1879	...	31st Mar. ,,							
Sholapur	...	,,	...	,, R. Bowman	...	...	1st April ,,	...	18th Aug. 1878	...	Balvantráo Nilkant	...	...	1st ,, ,,	...	22nd Nov. 1878.
				Surgeon-Major H. P. Jervis	...	...	19th Aug. ,,	...	22nd ,, ,,	...	Rhamim Sutkaljee	...	...	23rd Nov. ,,	...	31st Mar. 1879.
				Surgeon W. M. Conaghy	...	...	23rd ,, ,,	...	17th Sept. ,,							
				,, H. M. Calman	...	...	18th Sept. ,,	...	1st Mar. 1879.							
				,, C. Monks	...	...	2nd Mar. 1879	...	21st ,, ,,							
Ratnagiri	...	,,	...	,, H. M. Calman	...	...	22nd ,, ,,	...	31st ,, ,,							
				Surgeon-Major C. Joyut	...	...	1st April 1878	...	19th May 1878	...	Máhádev Kadam	...	...	1st April ,,	..	31st ,, ,,
Karwar	...	,,	...	Surgeon F. C. Barker	...	...	20th May ,,	..	31st Mar. 1879.							
				R. G. C. Westbrooke, Esq., Port Officer			1st April ,,	...	31st ,, ,,	...	G. W. M. D'Aranji	...	...	1st ,, ,,	..	31st ,, ,,

The meteorological observations recorded at these observatories are collected, reduced, corrected, and condensed in the Bombay Office, and regularly forwarded to the Meteorological Reporter to the Government of India for discussion and incorporation in the annual reports of the department. The information, thus obtained, affords a fairly complete and accurate view of the meteorology of the presidency of Bombay (including Sind), Rajputana, Central India, and Berar.

INSPECTION OF STATIONS.—During the year under report, I have inspected the observatories at Malegaon, Poona, Deesa, Mount Abu, Surat, Kurrachee, Hyderabad (Sind), Jacobabad, and Satara, and have found them in the condition briefly described below.

Poona.—This observatory was inspected in July 1878: everything was found in good order. The main object of my visit was to supervise the erection of a new anemograph at the Yerrowda Jail, where a new observatory has been equipped to supersede the old one at the Manourie Hospital.

Malegaon.—I inspected this observatory in October 1878, and found all the instruments in serviceable condition. There were, however, several defects in this arrangement. The thermometer shed is built with its longer axis east and west, instead of north and south; the barometer had been placed in the meteorological shed, instead of in-doors; and the anemometer had not been fixed in a perfectly satisfactory position. I gave instructions for the rectification of the anemometer, and placed a new barometer in the hospital building. The various instruments were compared with my standards, and I took away the old barometer, the cistern of which, by exposure to the weather, had become internally so dirty that it would soon have become unserviceable as an accurate instrument. In all other respects the observatory was in very good order.

Deesa, Mount Abu, and Surat.—I inspected these observatories in January and February 1879. At Deesa a new observatory has been established, in an exposed situation, to eventually supersede the old one, the position of which is unsatisfactory. Observations were commenced at the new observatory on the 1st of November 1878. Besides the usual set of meteorological instruments for eye observations, this observatory is furnished with a large anemograph, which has been erected on a tower specially built for the purpose. At the time of my visit, the anemograph, though erected, was not in working order, and I found, on dismounting it, that one portion of the machine had been distorted. When this had been straightened and the instrument re-erected, everything worked smoothly. Anemograms have been obtained from the 16th January 1879. I determined the azimuth of a distant fixed mark, by means of which it will be possible to check at any time the indications of the direction pencil.

All the thermometers and barometers were compared with my standards, and found, with one exception, in good order. The exception was a spirit minimum thermometer, which read about half a degree too low. It was rectified and placed in such a position that its accuracy would thereafter be assured.

On taking comparative sets of readings of the various instruments with the observer, it was noticed that, while all his readings of the thermometers were very accurate, his barometer readings indicated a remarkable constant discrepancy, the cause of which, on further enquiry, was satisfactorily elucidated. I had before noticed a sudden change in the readings of the Deesa barometer, as compared with those of the surrounding stations, and had expected to find some defect in the instrument. It was, however, in good order. The observed discordance in the barometric results was satisfactorily accounted for by the discovery of the discrepancy in the observer's method of reading, and the correction of the observations for this unexpected source of error was thereby rendered possible.

At Mount Abu Observatory, everything was found in good order, except that the north line of the wind-vane had been fixed, not to true north, but to 7° east of north. In accordance with my usual practice, all the instruments were compared with standards and their accuracy tested. The observer did not know how to read the anemometer correctly, but before leaving I taught him how to do so.

At Surat all the instruments were found in good order, with the exception of the nocturnal radiation thermometer. This was rectified, and the observer was shown how to keep it in order.

All the instruments were tested in the usual manner. The continued use of the clock-tower in the native town for the exposure of the anemometer having been refused, the instrument was fixed on a post erected on one of the bastions of the castle, and a medical pupil from the civil hospital was taught how to keep the register and attend to the instrument.

Kurrachee, Hyderabad, Jacobabad, and Satara.—I inspected all these stations in the month of March 1879.

At Kurrachee the observatory was found temporarily closed, the observer having been called away for a course of military instruction, and no arrangement having been made to continue the meteorological work during his absence. The instruments were all in good order. They were all tested by comparison with the standard instruments.

At Hyderabad Observatory two instruments were found out of order, *viz.*, the barometer and the nocturnal radiation thermometer. The former was exchanged and the latter rectified, and the observer was taught how to keep it in order. The rest of the instruments were in good condition. They were all compared with the standards.

At Jacobabad all was in good order, except one of the wet-bulb thermometers, which was found partially dry. The cause of the defect was pointed out to the observer for future guidance. All the instruments were tested by comparison with my standards.

At Satara everything was found in good order. The observer records the readings of the various instruments very correctly.

The accuracy of the instruments at the observatories which have been recently inspected may be judged by the following statement, which shows how much the corrected readings of each instrument differed from the corrected readings of the standard instruments at the time of inspection :—

Stations.	Sibpat.	Kurrachee.	Hyderabad.	Jacobabad.	Satara.	Deesa Old Observatory.	Deesa New Observatory.	Malegaon.	Mount Abu.	Karwar.	Ratnagiri.	Sholapur.
Month.	Feb. 1879.	March 1879.	March 1879.	March 1879.	March 1879.	January 1879.	January 1879.	October 1878.	January 1879.	January 1878.	January 1878.	December 1877.
	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
Barometer	+·001	+ 003	...	— ·009	+ ·006	× ·006	+ ·001	+·001	+·001	— ·002	—·007	+ ·004
	°	°	°	°			°	°	°			
Dry-bulb Thermometer ...	+ 0·3	0·0	0·0	+ 0·2	...	...	+ 0·1	+ 0·1	+ 0·1	...	...	...
Wet-bulb Thermometer ...	+ 0·2	0·0	— 0·1	+ 0·3	...	...	+ 0·1	—0·1	—0·1	...	...	...
Dry Maximum Thermometer	0·0	— 0·1	+ 0·1	0·0	...	...	— 0·1	0·0	0·0	...	...	
Dry Minimum Thermometer	0·0	0·0	+ 0·1	0·0	...	...	— 0·2	+ 0·1	+ 0·1	...	...	...
Wet Minimum Thermometer	+ 0·1	— 0·1	0·0	— 0·5	...	...	— 0·1	—0·1	0·0	...	...	
Grass Minimum Thermometer.	— 0·5	+ 0·1	— 0·2	— 0·1	...	...	— 0·2	+ 0·1	0·0	...	...	

METEOROLOGICAL ERECTIONS.—Meteorological sheds of the standard pattern have been erected at Karwar, Salara, Poona, and Deesa, and the construction of one at Belgaum has been sanctioned. A tower for the anemograph has been built at Deesa, and a small wooden room for the accommodation of a similar instrument has been constructed on the top of the watch tower of the Central Jail near Poona. Posts or other constructions have been provided for small anemometers at Rajkot, Akola, Surat, Indore, and Neemuch, and the thatch of the meteorological shed at Karwar has been renewed.

INSTRUMENTS AND THEIR VERIFICATION.—The number of new instruments verified and issued was 53. Of these, 15 were needed to replace breakages (chiefly nocturnal radiation thermometers, of which 7 were broken), 6 in place of instruments that had become deranged, 3 of which were barometers that leaked at the cisterns, and 3 maximum thermometers from which the air specks had disappeared; 5 were simply exchanged, 4 of them being barometers which required to be cleaned or repaired, 4 were issued to replace instruments that were stolen, and 13 issued for the first time.

A complete new set of verified instruments has been furnished to the voluntary observatory at Satara.

At 13 of the 22 observatories, no instrument was broken, and the observers deserve praise for their carefulness. One instrument was broken at each of 6 observatories, two were broken at Neemuch and two at Poona, while Amraoti holds an unenviable position at the head of the list with three broken. Amongst the instruments issued were two large anemographs, one of which was sent to Deesa, and the other to Belgaum. A small embossing anemometer has also been sent to Poona. Two of these instruments, *viz.*, those sent to Deesa and Poona, have been erected, but that forwarded to Belgaum awaits the construction of a tower for its accommodation, for which purpose there are at present no funds available. When these anemographs, and the one still in store, were received from Calcutta, they were all found to be more or less broken and damaged, either from faulty packing or rough usage, or both; but through the kindness of Colonel Fuller, Superintending Engineer, Bombay, they were all repaired in the workshop attached to his office, before being repacked and forwarded to their destinations.

TRAINING OF OBSERVERS.—Four soldiers have been trained to perform the meteorological work at second class stations, and one hospital assistant has been taught, at his own request, how to keep a meteorological register at a third class observatory. Some of the observers appointed during the year have had no special training in Bombay, but only such teaching as their predecessors have given them at the stations, supplemented by the correspondence pointing out defects as they arose, and in some cases by help kindly given by the medical officers in charge of the observatories. As all the third class observerships are held merely as adjuncts to other offices, it is impracticable to fill vacancies as they occur with chosen men who have gone through an observer's training. Whenever an observatory is inspected, however, the opportunity is taken to give the observer any further instruction he may seem to require.

METHODS OF OBSERVATION AND REDUCTION.—The only change was the stoppage, at the end of June 1878, of the experimental dew-point observations with a Regnault hygrometer at the second class observatories. The observations now accumulated are probably sufficient to enable a satisfactory comparison to be instituted between the dew-point, as determined by calculation from observations of the dry and wet bulb thermometers, and as found by direct observation with Regnault's hygrometer. If further observations are required to determine to what extent August's formula is applicable for the calculation of the amount of vapour in the air from readings of the dry and wet bulb thermometers, it would probably be advisable to employ the new hygrometer recently invented by Professor Fr. Schwackhöfer, and described in No. 16, Vol. XIII of the Journal of the Austrian Meteorological Society.

CHARACTER OF THE METEOROLOGICAL REGISTERS OF THE YEAR 1878.—With increased experience on the part of the observers, the defects pointed out in the last report have almost entirely disappeared, and the registers of the year 1878 appear, on the whole, to be accurate and trustworthy; any slight defects which have appeared during the year, being due mainly to occasional instrumental derangements. I have been compelled, however, to reject the registers from Poona for four days in January and nine days in December, as the recorded readings are evidently unreliable. These observations were made during the absence of the regular observer by a substitute, who appears, in some cases, to have drawn upon his imagination, instead of honestly recording the readings of the instruments. With one exception, the registers have been received from all stations with regularity and punctuality. The exception is Kurrachee, at which station it appears that the observer had been allowed to undertake other duties in addition to his meteorological work, and that he was consequently unable to perform in due time the increased amount of labour recently laid upon him. At this station the observer has been changed, and the returns are now being received with greater regularity.

OFFICE ESTABLISHMENT.—The office establishment remains the same as in the previous year. Its strength is barely sufficient to keep up the current work of the office, even although all its members work very hard. The establishment is quite unable to undertake any special investigation involving

much labour, or any additional current work, and no leave on allowances can be granted, although the unusually laborious nature of the work makes it very desirable, and sometimes absolutely necessary, that relief should occasionally be obtained. * * *

There have been many changes among the soldier-observers at the second class stations; indeed, except at Deesa, all the soldier-observers have been changed, and at Poona and Belgaum more than once. The departure of Lance Corporal G. A. Newman from Belgaum was a great loss from the subordinate ranks of the department.

WORK OF THE OFFICE.—The work of the office during the year has consisted almost entirely in the regular collection and laborious correction and reduction of the meteorological observations, recorded at about twenty observatories of the second and third classes, and in the maintenance of these observatories in efficient and, as far as possible, continuous operation. The observations of any particular month are usually completely reduced and despatched to Calcutta by about the middle of the second following month, when an abstract of the results is also published in the *Bombay Government Gazette*.

As already explained, the present establishment is calculated on a scale which barely suffices for the current work of the office, and, although it was originally contemplated that some portion of my own time would be available for devotion to special meteorological investigations, * * * * * I have not yet succeeded in obtaining any establishment for special work of this kind. I have, however, since the close of the year, succeeded in completing a special paper on the winds of Kurrachee, and have submitted it to the Meteorological Reporter to the Government of India for publication in the "Indian Meteorological Memoirs." In this paper, an endeavour has been made to distinguish and separate the winds which are due to local influences, and which have a limited sphere of action, from those which are due to more general causes and have a wide incidence. It would seem probable that the summer rainfall of by far the greater portion of India is drawn from the Arabian Sea rather than from the Bay of Bengal; and if so, it is particularly desirable that the telegraphic system designed for the prognostication of the summer rains should furnish information from the western, as well as from the eastern coasts of the Arabian Sea.

I have also made a short communication to *Nature* on the relation which exists between the variations from year to year of the barometric pressure at Bombay and the sun-spots,—a relation which goes far to strengthen the belief in a connection between weather disturbances generally and the variations which take place in the condition of the solar atmosphere.

In another short communication to the Meteorological Society of London on the diurnal variations of the barometric pressure in the British Isles, I have pointed out that the hourly differences of the barometric pressure at inland and coast stations give a curve of the same form as that representing the diurnal variations of air temperature, and that the pressure differences are such as satisfy the requirements of the convection current theory of the land and sea breezes.

A brief sketch of the meteorology of the Bombay Presidency in 1877 has also been prepared and published in the General Administration Report of the Bombay Government. In this paper, as well as in the sketch for 1876, the method of comparing abnormal meteorological variations at a few selected stations was exclusively used, and it was shown that the relations existing between the abnormal variations are, to a great extent, the same as those obtaining between the normal variations; and that they are, therefore, susceptible of similar explanation. The rainfall distribution of the monsoon season was shown to be largely dependent on certain well ascertained physical principles.

APPENDIX F.

Statement showing the names of Superintendents and Observers at the several Observatories of British Burma during the year 1878-79.

Stations.	Names.	Appointment.	Remarks.
Rangoon ...	Surgeon G. A. Dundas ...	Superintendent ...	Throughout the year.
	W. R. Marshall	Observer ...	From 1st April 1878 to 10th January 1879.
	G. W. Bird	Ditto ...	„ 11th January to 31st March 1879.
	R. Donald	Assistant Observer	Throughout the year.
Moulmain ...	Surgeon-Major W. F. DeFabeck	Superintendent ...	Throughout the year.
	Hospital Assistant Mobarik Ali ...	Observer ...	From 1st April to 19th December 1878.
	Ditto Ruthnasawmy	Ditto ...	„ 20th December 1878 to 31st March 1879.
Thyetmyo ...	Surgeon Oswald Baker, I.M.D.	Superintendent ...	From 1st April to 12th December 1878.
	„ H. J. Hazlett, I.M.D. ...	Ditto ...	„ 12th December 1878 to 31st March 1879.
	Hospital Assistant Ahmed Ally ...	Observer ...	Throughout the year.
Bassein ...	Dr. C. W. E. Foster ...	Superintendent ...	From 1st April to 16th December 1878.
	Surgeon Oswald Baker, I.M.D.	Ditto ...	„ 17th December 1878 to 1st February 1879.
	Hospital Assistant Assiff Zuman	Observer ...	„ 1st April to 21st September 1878.
	A. G. Soon	Ditto ...	„ 22nd September 1878 to 31st March 1879.
	Surgeon R. S. Dawson ...	Superintendent ...	„ 2nd February to 31st March 1879.
Tounghoo ...	Surgeon R. V. Power ...	Ditto ...	Throughout the year.
	Hospital Assistant Paul, of 41st N. I.	Observer ...	Ditto.
Mergui ...	Assistant Apothecary R.S. Dawson	Superintendent ...	From 1st April 1878 to 14th January 1879
	Surgeon L. R. Dawson ...	Ditto ...	„ 15th January to 31st March 1879.
	Maung Shoay Htoon ...	Observer ...	„ 1st April to 2nd November 1878.
	Mahomed Cassim	Ditto ...	„ 3rd November 1878 to 31st March 1879.

RANGOON,
The 11th June 1879.

W. R. KELLY,
Sanitary Commissioner, British Burma.

APPENDIX G.

List of Stations for which the rainfall registers of past years have been tabulated.

PUNJAB.

Delhi	1844-52, 1859-78.	Hoshiarpur	1857-78.
Gurgaon	1844-51, 1861-78.	Gurdaspur	1859-78.
Hissar		Abbottabad	
Kurnal	1844-50, 1862-78.	Amritsar	1860-78.
Rohtak		Montgomery	
Sirsa	1844-51, 1858-78.	Mozuffergarh	
Ferozepore	1844-55, 1862-78.	Jhelum	1861-78.
Amballa	1850-78.	Simla	1862-78.
Ludhiana	1850-56, 1862-78.	Gujranwalla	
Lahore	1851-54, 1861-78.	Gujrat	
Jullundur	1852-78.	Mooltan	
Sialkot	1852-54, 1861-78.	Jhang	
Rawalpindi	1852-53, 1860-78.	Dera Ismail Khan	
Dhurmsala	1853-54, 1861-78.	Dera Ghazi Khan	
Peshawar	1853-56, 1862-78.	Bannu	
Shahpur	1854-78.	Murree	1875-78.
Kohat	1854-56, 1862-78.	Leh	1876-78.

RAJPUTANA.

Kherwara	1857-78.	Alwar	1871-73, 1875-78.
Mount Abu	1860-78.	Bikanir	1872-78.
Deoli	1861-78.	Kota	
Ajmere	1863-78.	Tonk	
Nusseerabad	1866-78.	Shahpoora	1873-78.
Bhurtpore	1866-68, 1871-78.	Banswara	
Erinpoora	1867-78.	Oodeypore	1874-78.
Jeypore		Jodhpur	
Kotra	1870-78.	Sambhar	1875-78.
Jhalrapatam	1871-78.		

CENTRAL INDIA.

Neemuch	1860-69, 1877-78.	Sirdarpur	1868-78.
Nagode	1863-78.	Goona	1871-78.
Nowgong	1868-78.	Rewah	1872-78.
Bhopal		Sutna	
Indore		Manpur	
Rutlam		Morar	
Agar			

NORTH-WESTERN PROVINCES.

Agra	1844-56, 1864-78.	Cawnpore	1844-50, 1864-78.
Furruckabad	1844-53, 1864-78.	Shajihanpur	
Almora	1844-51, 1861-62, 1864-78.	Muttra	
Meerut	1844-51, 1864-78.	Mainpuri	
Moradabad		Banda	
Bareilly		Allahabad	
Etawah		Jaunpur	
Fatehpur		Mirzapur	
Hamirpur		Pauri	
Azamgarh		Roorkee	1848-50, 1863-78.
Benares		Naini Tal	1849-51, 1863-78.
Gorakhpur		Etah	1864-78.
Ghazipur		Ruderpore	
Dehra Dun		Jalaun	
Shaharanpore	1844-50, 1864-78.	Lalitpur	
Mozaffernagar		Jhansi	1865-78.
Bolundshahr		Basti	1866-78.
Aligbar		Chakrata	1869-78.
Bijnour		Ranikhet	1871-78.
Budaon			

OUDH.

Lucknow	1867-78.	Fyzabad	1867-78.
Oonao		Bahraich	
Barabanki		Rai Barili	
Sitapur		Sultanpur	
Hardai		Purtabgarh	
Kheri		Gonda	1868-78.

BENGAL.

Calcutta	... 1829-78.
Dacca	... 1827-34, 1852-54, 1860-78.
Bankoora	... 1831-32, 1853-54, 1859-78.
Darjeeling	... 1837, 1850-55, 1860-62, 1867-78.
Patna	... 1842-47, 1849-56, 1868-78.
Jessore	... 1848-54, 1859-62, 1866-78.
Berhampore	... 1848-52, 1859-78.
Malda	... 1848-52, 1860-78.
Mozafferpore	... 1848-54, 1860-63, 1867-78.
Rungpore	... 1848-54, 1860-62, 1867-78.
Chittagong	... 1848-54, 1860-61, 1864-78.
Soory	... 1848-54, 1867-78.
Monghyr	... 1848-52, 1854, 1859-78.
Hazaribagh	... 1848-52, 1854, 1860, 1867-78.
Cuttack	... 1848-52, 1860-63, 1867-78.
Purulia	... 1848-52, 1867-78.
Pooree	... 1848-52, 1854, 1860-61, 1863-78.
Ranchi	... 1848-52, 1860-78.
Noakhally	... 1848-52, 1860-78.
Bhagulpore	... 1848-51, 1853-54, 1860-78.
Rampore Bauleah	... 1851-54, 1859-78.
Chupra	... 1849-54, 1859-78.
Gya	... 1849-54, 1860, 1867-78.
Arrah	... 1849-52, 1860-78.
Motihari	... 1849-51, 1859-63, 1867-78.
Pubna	... 1851-54, 1866-78.
Comillah	... 1852-54, 1860-78.
Mymensingh	... 1852-54, 1864-78.
Burrisal	... 1852-54, 1868-78.
Furreedpore	... 1853-54, 1869-78.
Dinagepore	... 1854, 1859-78.
Midnapore	... 1854, 1861-63, 1867-78.
Bogra	... 1854, 1860-61, 1863-78.
Hooghly	... 1854, 1865-78.
Balasore	... 1859-78.
Burdwan	... 1860-78.
Krishnagar	... 1861-78.
Saugor Island	... } 1867-78.
False Point	... }
Howrah	... 1868-78.
Julpigori	... }
Buxa	... }
Rungamati Hill	... } 1869-78.
Chyebassa	... }
Alipore	... 1870-78.
Nya Doomka	... }
Purneah	... } 1871-78.
Durbhanga	... }
Agartollah	... }
Cooch Behar	... } 1872-78.
Mongpoo	... 1873-78.

ASSAM.

Gauhati	... 1848-78.
Dibrugarh	... 1848-56, 1868, 1870-78.
Nowgong	... 1848-54, 1860, 1862-78.
Sibsagar	... 1848-54, 1862-78.
Sylhet	... 1849-55, 1860-78.
Tezpur	... 1849-54, 1860-1878.
Cachar	... 1849-54, 1863-78.
Goalpara	... 1849-54, 1868-78.
Cherra Punji	... 1851-54, 1860-61, 1863-69, 1871-78
Nazirah	... 1861-77.
Shillong	... 1866-78.
Samagooting	... 1869-78.
Tura	... 1870-78.

CENTRAL PROVINCES.

Nagpur	... 1826-32, 1854-78.
Jubbulpore	... 1844-78.
Baitul	... 1844-54, 1863-78.
Nursingpur	... 1844-52, 1863-78.
Saugor	... 1844-52, 1864-78.
Hoshangabad	... 1844-51, 1854, 1863-78.
Damoh	... }
Seoni	... } 1844-50, 1863-78.
Mandla	... }
Bhandara	... }
Chanda	... } 1863-78.
Wardha	... }
Chindwara	... }
Raipur	... }
Sambalpur	... } 1863-78.
Bilaspur	... }
Sironcha	... }
Hinganghat	... }
Khandwa	... 1865-78.
Balaghat	... 1867-78.
Pachmarhi	... 1871-78.

BERARS.

Amraoti	... 1859-78.
Elichpur	... 1859-67, 1869-78.
Woon	... 1859-69, 1876-78.
Buldana	... 1859-61, 1865-78.
Akola	... 1861-78.
Yeotmul	... 1865-78.
Bassim	... 1866-78.
Chikalda	... 1866-70, 1876-78.

HYDERABAD.

Secunderabad	... 1843-78.
Hingali	... 1864-78.
Hyderabad (Residency)	1869-78.
Bolarum	... 1870-78.
Aurungabad	... 1875-78.
Lingsagur	... 1876-78.

BOMBAY.

Bombay	... 1817-78.
Malcolm Path	... 1820, 1842, 1844-47, 1867-78.
Poona	... 1826-30, 1842, 1844-49, 1861-78.
Satara	... 1836, 1844-48, 1861-78.
Belgaum	... 1841-43, 1847, 1861-64, 1867-78.
Ahmedabad	... 1843, 1862-78.
Nassick	... } 1844-47, 1861-78.
Ahmednagar	... }

BOMBAY—continued.

Ratnagiri	1844-47, 1861-78.	Esplanade	1862-78.
Tanna	1844-47, 1862-78.	Broach	
Dharwar	1844-47, 1861-65, 1867-74, 1876-78.	Hubli	1862-72, 1874-78.
Kolhapur	1847, 1861-78.	Nargand	
Sholapur	1853-78.	Kalghatgi	1862-72, 1874-78.
Poona (Obsy.)	1856-78.	Baura	1862, 1863, 1874-78.
Belgaum (Obsy.)		Surat	1863-78.
Kurrachee (Obsy.)		Nagar	
Deesa (Obsy.)		Hyderabad	
Dhulia	1861-78.	Shikarpore	1863-70, 1872-78.
Malegaon		Umarkot	1863-69, 1874-78.
Karwar		Sehwan	1865-70, 1872-78.
Kaira		Kaladgi	1866-76.
Rajkot		Godhra	1866-78.
Bhuj		Matheran	1866, 1868-78.
Jacobabad		Palunpur	1866-68, 1871-78.
Rohri		Edar	1868-78.
Igatpuri	1861-71, 1874-78.	Baria	1869-78.
Hanawar	1861-65, 1867-78.	Tatta	
Gokak	1862-78.	Lanauli	1874-78.
Bijapore		Mandargi	
Vingorla		Goa	1875-78.
Byculla			

MYSORE AND COORG.

Bangalore	1835, 1837-78.	Shimoga	1837-78.
Mysore	1837-78.	Mercara	1863-71, 1873-78.

MADRAS.

Madras	1813-78.	Conjeveram	1863-78.
Ootacamund	1829-33, 1863-68.	Caroor	
Trichinopoly	1842-48, 1853-54, 1861-78.	Aska	
Cochin	1842-46, 1853-54, 1863-78.	Ganjam	
Pasumallai	1846-66, 1868-71, 1877-78.	Coconada	
Bellary	1847-48, 1852-54, 1859-78.	Ellore	
Cuddapah	1852-78.	Masulipatam	
Guntoor	1852-54, 1863-78.	Dindigal	
Kurnul	1852-54, 1863-78.	Palghat	
Salem		Tellicherry	
Mangalore	1853-78.	Nellore	
Cuddalore	1853-54, 1863-78.	Ongole	
Coimbatore		Ahtur	
Madura		Shevaroy Hills	
Calicut		Combaconum	
Cannanore		Negapatam	
Tinnevelly	1854-55, 1863-78.	Tanjore	
Aska (Sugar Works)	1854, 1856-77.	Tranquebar	
Rajamundry	1854, 1863-78.	Tuticorin	
Gooty	1856-78.	Vizianagram	
Bimlipatam	1860-78.	Verdachellum	1864-78.
Arcot	1863-78.	Oodiarpallum	1865-78.
Chittoor		Vizagapatam	1866-78.
Palamanair		Manantoddy	1868-78.
Vellore		Gudalore	1868-78.
Tindevannum		Wellington	1875-78.
Chingleput			

BRITISH BURMAH.

Tavoy	1848-52, 1861-78.	Prome	1870-78.
Mergui	1848-51, 1868-78.	Tounghoo	
Akyab	1849-52, 1860-78.	Thyetmyo	
Moulmein	1850-78.	Rangoon	
Sandoway	1860-64, 1866-78.	Bassein	
Kyouk Phyoo	1866-78.	Henzada	1871-78.
Shwe Gyeen	1869-78.		

BAY ISLANDS.

Port Blair	1868-78.	Nancowry	1873-78.

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CORRECTION.

Page 8, line 4, *for* " 70°, 21 degrees," *read* " 17 and 21 degrees."

REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1879-80.

The year now under report completes the first *lustrum* of the existence of the Department;[1] and it may be of interest to preface the special report of the year's working, with a brief survey of what has been aimed at and accomplished during these five years, in which meteorological observation in India has been carried on under a regularly-devised system, and the results concentrated in a central office, for discussion and publication.

GENERAL REVIEW OF THE OPERATIONS OF THE FIVE YEARS, 1875—80.

At the beginning of 1875, there were, in India and its dependencies, 87 observatories of all classes (including private observatories and one in the Portuguese territory of Goa), the large majority of which had been established at intervals during the preceding ten years. Working on various systems and under independent and mutually isolated authorities in the different provinces, any collection and comparison of their results could be accomplished only by the voluntary co-operation of the controlling officers; and although this had been effected to some extent by the several Meteorological Reporters of Northern India and the Sanitary Commissioner of the Central Provinces, and it had thus become possible to obtain some general connected ideas on the meteorology of this part of India as a whole, yet, owing to the insufficient verification of instruments, the uncertainty that existed as to the elevation of many of the stations and other important constants, and, in some cases, the imperfect equipment of the observatories, and the ignorance of the observers themselves, a not inconsiderable portion of such data as could be brought together could be used only with doubt and misgiving; while a large part of

[1] The scheme of re-organisation submitted to Government in July 1875 was not sanctioned until the 27th September 1875, and the Department was therefore not formally established until that date. But my own appointment took effect from January in the same year, and much preliminary work had been done in anticipation of the above order. The statement in the text, therefore, expresses the actual fact.

India was either quite unrepresented by observatories, or, as in the case of the Bombay and Madras presidencies, the registers were absolutely inaccessible to the officers of other provinces.

Under such circumstances, the rational explanation of the meteorology of any portion of India, with any degree of completeness, was felt to be a hopeless task; and, indeed, any discussion of the registers, with a view to that end, was only too often carried out, with more or less misgiving, that sources of error might lurk undetected in the materials that served as data. With observers who had had, but in few cases, any proper training to the work, and superintendents many of whom had no more idea of the requirements of physical observation than was afforded by the medical education of 20 or 30 years ago, it will readily be conceived that the primary conditions of trustworthy observation but too often failed of fulfilment; and the valuable test of the work which is now afforded by the daily juxtaposition of a portion of the data of all stations on a weather chart, and by the detailed comparison and discussion of all results in a general annual report, were wanting; added to which, the inspection of stations and the examination of the instruments *in situ* had been carried out only in one or two provinces.

The objects aimed at in the re-organisation of the system are thus summarised in the Administration Report for 1875-76, the first annual report of the new department:—

1st.—A redistribution of the observatories, and such additions to them as would serve to represent fairly the meteorological conditions of the whole of the British provinces under the Government of India. It was proposed (*a*) to group low-lying and elevated stations in pairs, in order that they might throw light on the variations of the atmosphere in a vertical direction, and (*b*) in some cases, where the geographical conditions of two neighbouring stations are very different, it was proposed to provide observatories at both notwithstanding their proximity. With these exceptions, (*c*) as uniform a distribution was desired as the condition of the country and the existence of suitable stations would admit of.

2nd.—To render the data from all observatories comparable *inter se*, and also with well-known standards. To accomplish this, required (*d*) a rigorous comparison of the instruments used; (*e*) uniformity in the mode of exposure and methods of reduction; (*f*) the determination of certain local constants, especially of the elevation of the barometers above sea level; and (*g*) the acquisition of such a knowledge of the surroundings of each station, and especially of the observatory, as would enable some judgment to be formed of the influence of the form of the country and of local obstacles on the prevalent winds, of neighbouring tanks or irrigated tracts on the humidity of the air, &c.; and, lastly, (*h*) the determination of corrections which, when applied to two or three sets of observations recorded daily, should eliminate those differences which depend on the diurnal oscillation of each element.

3rd.—(*i*) The establishment of one or two observatories of a higher class in the interior of India, as well as on the coasts, which may furnish detailed and continuous registers, and at the same time serve as depôts for verifying instruments, training observers for the minor stations, and for carrying on such experiments and enquiries as require special knowledge and training.

4th.—To provide for the more effectual supervision of the work of all observatories, by (*k*) relieving the local Reporters of a large part of their former duties, which were

thenceforth to be undertaken by the general department; also (*l*) to provide an additional local Reporter for Western India.

5th.—To bring together the materials furnished by the observatories in all parts of India, and, as far as possible, from adjacent regions, (*m*) for the purpose of discussion and publication; and this with the least possible delay.

I shall now review categorically the steps which have been taken to give effect to each of these proposals, and also the measure of success that has attended them.

1. Distribution of Observatories.

(*b*) (*c*).—In the report on the re-organisation of the Department, it was proposed to establish twenty-two new observatories to represent those parts of India in which the information then available was most deficient, and to abandon five of those then existing, which were but little needed, owing to their proximity to others. The net increase as proposed was therefore seventeen. Of the new stations, six were in Rajputana and Central India, two in the Punjab, one in Berar, one in the Central Provinces, nine in Bombay, one in Madras, and two in the native state of Ava. All these have now been established, with the exception of the two last mentioned, which, owing to the disturbed state of that kingdom, are unavoidably in abeyance. One of them, indeed, was at work for a few months of the past year, but was relinquished on the withdrawal of the mission.

In addition to those originally proposed, one observatory has been established in Rajputana, one in the Punjab, two in the North-Western Provinces, one in Central India, one in Berar, two in Bengal, one in Bombay,[1] two in Madras, one in Burma, and three in frontier states; one at Bushire in the Persian Gulf, and one at Aden. Steps have also been taken to establish observatories at Zanzibar, and at Amini Divi, one of the Maldive Islands; but these and the Aden observatory were not in operation at the end of the year.

On the other hand, one of the five stations which it was proposed to abandon, *viz.*, Meerut in the North-Western Provinces, was retained at the expense of the municipality, but one Punjab station, Bahawalpore, which existed as an independent station in 1875, has ceased to contribute registers.

There were, therefore, at the end of the year under report, one hundred and seventeen stations in India and neighbouring countries, contributing original registers to the Meteorological Office; not including the observatories in Ceylon, the registers of which are received in the form of abstracts, and as such are included in the annual reports. The area of observation has thus been extended beyond the limits of India in all directions; while in India itself, no part remains unrepresented, in which the presence of competent officials renders practicable the establishment of an observatory. It cannot indeed be asserted that all parts are as yet adequately represented; and it is evident, on a glance at the map, that while some portions of the country are provided with numerous observatories, in others they are somewhat sparsely scattered. Thus, in the Central Provinces and Berar, the high plateaux and hill groups of the Satpuras have three observatories, *viz.*, Chikalda, Pachmarhi, and Seoni, at elevations respectively of 3,656, 3,504, and 2,030 feet; while, at the northern foot of the range, in the Nerbudda valley, there are also three stations —Jubbulpore, Hoshangabad, and Khandwa—at elevations of 1,351, 1,020, and 1,042 feet; and to the south, on the plains of Berar and Nagpur, Akola, Amraoti, and Nagpur

[1] This was relinquished before the end of the year under report.

at 930, 1,202, and 1,025 feet. But the Satpura range is a geographical feature which exercises a very important influence on the local meteorology, and it can hardly be asserted that these stations are unduly crowded. On the other hand, there are still tracts in which some additional observatories are desirable, and in one of these at least, *viz.*, the northern part of the Madras Presidency, there are one or two stations available for the purpose which I hope before long to utilise. An observatory at Cuddapah, for example, and others at Kurnool and at Rajahmundry, would be a highly desirable addition to the system. In the wild hilly country to the east of the Central Provinces, also, there are but two stations, *viz.*, Sambalpur and Raipur; and Bastar and Jeypore to the south are quite unrepresented; but, in the absence of civilised settlements, any further provision in this region is at present impracticable. The arid and thinly-inhabited tract in Western Rajputana has now been fairly provided for, by the establishment of an observatory at Bickaneer, and quite recently—thanks to the exertions of the Commissioner of Inland Revenue, Mr. Halsey—by one at the office of the Salt Agency at Pachbudra, and another at Sambhar.

(*a*).—The importance of the comparative observations of pairs of neighbouring stations, on the hills and plains respectively, has been recently brought into unexpected prominence by the discovery of the fact that the condition of the higher atmosphere sometimes varies in an opposite direction to that of the lower strata, and is probably an important factor in determining that persistency of certain conditions which observation has shown to be a characteristic feature of Indian meteorology. The evidence of this has been given at some length in the recently-issued Report on the meteorology of 1878, wherein it has been shown, from the evidence of the hill stations, that the abnormally high pressure, which prevailed over India from the summer of 1876 to that of 1878, was due mainly to the condition of the higher atmospheric strata. The pairs of stations which are now available for the discussion of questions of this character, are the following:—

Hill stations.	Elevation.	Plain stations.	Elevation.	Difference.
	Feet.		Feet.	Feet.
Murree	?	Rawalpindi	1,652	?
Simla	6,953	Ludhiana	806	6,147
Chakrata	7,052	Roorkee	887	6,165
Chakrata	7,052	Dehra	2,232	4,820
Mussooree	?	Dehra	2,232	?
Ranikhet	6,069	Bareilly	568	5,501
Darjeeling	6,912	Goalpara	386	6,526
Mount Abu	3,945	Deesa	474	3,471
Chikalda	3,656	Amraoti	1,202	2,454
Pachmarhi	3,504	Hoshangabad	1,020	2,484
Ootacamund	7,252	Coimbatore	1,348	5,904
Wellington	6,200	Coimbatore	1,348	4,852

The following is a list of all the stations from which registers were received during the year 1879-80, classified as in the table published in the Administration Report for

1875-76. The names of those established since March 1875 are printed in capitals :—

List of Meteorological Observatories in 1879-80.

Provinces.	1st Class.	2nd Class.	3rd Class	Voluntary and independent.
Persian Gulf ...	.....	.....	.....	BUSHIRE.
Beluchistan ...	.....	.....	QUETTA.	
Kashmir ...	.....	Leh ...	GILGIT.	
Punjab ...	Lahore ...	.....	Mooltan.	Simla.
			THULL.	
			Dera Ismail Khan.	
			PESHAWAR.	
			Rawalpindi.	
			Murree.	
			Sialkot.	
			Ludhiana.	
			SIRSA.	
			Delhi.	
Rajputana and Central India States.			Ajmere ...	SAMBHAR.
			BICKANEER ...	NOWGONG.
			MOUNT ABU.	
			NEEMUCH.	
			PACHBUDRA.	
			INDORE.	
			SUTNA.	
N.-W. Provinces and Oudh.	Allahabad ...	Agra ...	Ranikhet.	MUSSOOREE (2).
		Roorkee ...	Chakrata.	Meerut.
		Lucknow ...	Bareilly.	Dehra.
			Benares.	
			Gorakhpur.	
			Jhansi.	
Bengal ...	Calcutta (Alipore).	Patna ...	Darjeeling.	Durbhanga.
		Hazaribagh ...	Purneah.	DEMAGIRI.
		Cuttack ...	Gya.	MOUNGPOO.
	"	Saugor Island ...	Berhampore.	
		Chittagong ...	Jessore.	
			Dacca.	
			Burdwan.	
			False Point.	

Provinces.	1st Class.	2nd Class.	3rd Class.	Voluntary and independent.
Assam	...	Sibsagar ...	Silchar.	
	...	Goalpara.		
Nepal ...	...	...	...	KHATMANDU.
Central Provinces ...		Nagpur ...	Saugor.	
		Jubbulpore ...	Hoshangabad.	
		Pachmarhi ...	Khandwa.	
			Seoni.	
			Raipur.	
			Sambalpur.	
			Chanda.	
			SIRONCHA.	
Berar ...			Amraoti.	MAKHLA.
			Akola.	
			CHIKALDA.	
			Buldana.	
Bombay ...		Belgaum ...	JACOBABAD.	Bombay (Colaba).
		Poona ...	HYDERABAD.	SALARA.[1]
		Deesa ...	BHUJ.	KARWAR.
		Kurrachee ...	RAJKOT.	
			SURAT.	
			MALEGAON.	
			SHOLAPUR.	
			RATNAGIRI.	
Goa ...	...	...	...	Goa.
Hyderabad ...	...	...	Secunderabad.	
Mysore and Coorg ...	...	...	Bangalore.	
			MERCARA.	
Madras ...			Cochin.	Madras.
			MANGALORE.	Vizagapatam.
			Madura.	OOTACAMUND.
			Coimbatore.	
			Salem.	
			Trichinopoly.	
			Negapatam.	
			Wellington.	
			Bellary.	
			Masulipatam.	

[1] Relinquished on the 10th March 1880.

Provinces.	1st Class.	2nd Class.	3rd Class.	Voluntary and independent.
Burma ...		Rangoon ...	Akyab. Thyet Mio. Bassein. Tounghoo. Moulmein. Mergui. MANDALAY.[1] DIAMOND ISLAND.	
Bay Island Settlements ...			Port Blair. Nandowry.	

2. MEASURES TO ENSURE UNIFORMITY AND ACCURACY.

(*d*).—Among the first steps taken on my return to India, in 1875, was to recall, for verification, all thermometers and barometers that had not been recently compared with standard instruments, and to replace them by others that had been duly verified. All such instruments at the observatories of the Punjab, the N.-W. Provinces, the Central Provinces, and Bengal were brought for this purpose to Calcutta. In Madras, Mr. Pogson had, I believe, already verified the instruments in use, with the exception of the sun thermometers; and in Bombay Mr. Chambers verified the instruments of the four existing observatories under his charge, and also verified, before issuing them, all instruments that were supplied to newly-established observatories. Thus, all past observations made with instruments in use in 1875, as well as the contemporary and future registers, could be corrected to the standards adopted. The three standard barometers of the observatories of (*a*) Calcutta, (*b*) Madras, and (*c*) Bombay were, and are, the local standards of reference for the barometrical registers respectively of (*a*) all stations under the Meteorological Reporters of Bengal, the N.-W. Provinces, and the Punjab, and the Sanitary Commissioners of the Central Provinces and Burma; (*b*) the observatories in Bombay, Berar, and Rajputana (excepting Ajmere, Pachbudra, and Sambhar); and (*c*) Madras, Mysore, and Hyderabad. But steps were also taken to obtain an indirect comparison between the Bombay and Calcutta standards; and corrections have thus been determined, by which all the barometric registers of Western as well as Northern and Central India are reduced to terms of the Calcutta standard. For Madras, this has not yet been accomplished; but instruments compared with the Calcutta standard have been issued to Masulipatam and the recently-established observatories of Ootacamund, Mangalore, and Mercara. It is hoped that, under the new arrangements now about to be made in Madras, the remaining stations in that Presidency will no longer form an exception.

The thermometers, excepting those for solar radiation, are compared at their freezing points in ice, and at higher temperatures with Kew standards in the possession of the Meteorological Reporters for India, Western India, and Madras respectively. A similar comparison of thermometers for solar radiation is not attempted, being in fact of little value, since it is found that instruments by the best makers, which give approximately identical readings in the shade, differ by amounts varying up to 12° and 15° when

[1] Abandoned in October 1879.

exposed to the sun. Some of Hicks' patent thermometers (in which the vacuum of the enclosing tube is carried up to the point at which an electrical discharge passes between two platinum electrodes at opposite ends of the tube) were found on a recent comparison to read 70°, 21 degrees lower than thermometers of the ordinary pattern manufactured by Casella, when exposed to the sun, on stands 4 feet high, in the open grassy compound of the Alipore observatory.

The verification adopted in the case of these instruments is therefore of an empirical character. They are compared, for 30 or 40 sunshiny days, with an arbitrary standard preserved at the Alipore observatory; or, more usually (in order to preserve the standard instrument from unnecessary risk of breakage), with secondary standards that have been thoroughly verified in the same manner with the primary standard; and all sun radiation temperatures (excepting those of the Madras observatories) are corrected to the Alipore standard.

With regard to anemometers, some experimental comparisons have been made at Alipore, but the results have not been such as to satisfy me that the reduction of the wind velocities to a common standard is at present practicable. But even were every precaution taken to eliminate the variations of the instruments employed but little progress would have been made towards uniformity, so long as the wind registers are affected by the existing differences in the elevations of the instruments. Improvements have been made in this respect at some of the observatories, but much remains to be done, especially at some of the least accessible, before this element of the observations can be considered satisfactory.

(*e*).—Uniformity in the exposure of thermometers had been so far attended to in the North-Western Provinces, Bengal, the Central Provinces, and Madras, before the establishment of the general department, that at all stations, sheds, either open at the sides, or merely enclosed by lattice-work or louvres, had been provided for the thermometers and hygrometers. In the Punjab, this had been done only at one station, *viz.*, Lahore. At others, open stands, intended to be of Glaisher's pattern, were in use. But, in many cases, the stands in use at the time of my inspection of these stations in 1875, were found to present many deviations from the presumed pattern; and under the intense radiation of the Punjab sun in the daytime and the clear night skies, the temperatures shown by the thermometers suspended on them departed widely from those of the air, being exaggerated alternately in excess and defect. As was noticed by Mr. F. Chambers in his report for 1875-76, at the four old-established stations in the Bombay Presidency, there were great differences in the system of exposure. These inconsistent and objectionable methods of exposure were suppressed in 1875 and 1876; sheds open at the sides being substituted. At one or two stations, such as Benares, Allahabad, and Agra also, where sheds were in use the construction of which was such as either to afford insufficient protection to the instruments, or, on the other hand, too rigorous an enclosure, the defects of the arrangements have been corrected.

At the present time, sheds are in use at all stations, and thermometers are not allowed to be brought into use at a newly-established station, until a proper shed has been erected for their reception. To ensure uniformity, a lithographed drawing of an approved pattern is sent for the guidance of the superintending officer, and a copy of the same is also given in the official Manual of Instructions with which every observatory is provided. At a few stations in the Central Provinces, Berar, and the North-Western Provinces, where

the shed is erected in a situation which would expose the instruments to theft or injury, it has been enclosed by louvres or lattice, but I found recently, on comparing the temperatures registered in these sheds with that given by a sling thermometer outside in a shaded place, that there was no difference of importance between the two.

With respect to the hygrometric indications of thermometers exposed under open sheds, observations with a verified Regnault's hygrometer were made at a number of stations in the dry climate of the North-Western Provinces, the Punjab, and Madras, in March and April 1875 and 1876, and the results compared with those computed from the readings of the dry and wet bulb thermometers under the sheds. The result was a very close accordance of the two, even in extremely dry states of the atmosphere, provided there was a certain movement of air through the shed. An account of these observations was published in the XLVth volume of the Journal of the Asiatic Society of Bengal.

Uniformity of conditions in the exposure of the solar and nocturnal radiation thermometers is secured, as far as possible, by the use of stands for the former class of instruments, which raise them 4 feet above the ground; while protection against crows and other mischievous birds is afforded by a cage of sharpened wires, which covers the tube of the instrument; and by a pad of country blanket as a support for the latter, thus affording a radiating surface of a constant character. Previously to the introduction of this form of support, the thermometer was exposed sometimes on green—more frequently on dry—grass, but most often on bare ground, or a patch in which a half-dry tuft of grass was kept alive by assiduous watering.

With respect to anemometers, it has been observed above that uniformity is practically unattainable, and all that can be done is to select the best position for the instrument that the site of the observatory affords. Similarly with regard to wind vanes.

Barometers are in nearly all—and should be in all—cases, preserved in a masonry building. Despite the instructions that have been repeatedly issued on this point, I have found that, at one or two observatories, the objectionable practice of suspending the barometer in the thermometer shed is still adhered to. It is, however, nearly eradicated, but constant watchfulness on the part of inspecting officers is necessary to enforce the observance of the rule.

Rain-gauges are directed to be placed in all cases with the mouth 1 foot above the ground. Either from a re-actionary feeling against the prevailing native love of *dustoor*, or, as is more probable, from a simple failure to appreciate the importance of accuracy, which appreciation is only to be acquired by a regular scientific training, small variations in this respect are to be met with in many observatories; but the more objectionable practice of placing the rain-gauge on the roof of a building, formerly not uncommon, has, I believe, been everywhere suppressed; at least at all meteorological observatories; and, with the rarest exceptions, I have found that care has been taken to select a place for the gauge in which its indications shall not be falsified, on the one hand, by its being shaded by buildings or trees, or, on the other hand, by its receiving their droppings in addition to the actual rainfall. Incidents, such as that of an over-zealous superintendent at an Orissa station, some years since, who, on receiving a new and brightly-polished rain-gauge, applied for sanction to the expenditure of a small sum to erect a shed over it, to preserve its beauty from the impairing influence of the weather, belong, I hope and believe, to a bygone state of knowledge.

With respect to methods of observation and reduction, uniformity is now carried out as far as the observations admit of it. The guiding principle is, that all observations are reduced to such approximations to daily means as the number of the observations and the available means of correction will serve for; and all original observations are corrected for the known instrumental errors and local constants. This last is the most important, because the original observations being trustworthy, they can at any future time be corrected to more accurate daily or monthly means, by the application of corrections, hereafter to be determined. The steps that have been taken to ascertain these will presently be noticed. Meanwhile, there are only a few stations at which the diurnal variations of the several elements are known with sufficient accuracy to furnish the required corrections; and at the large majority of the observatories, the uncorrected mean of two or more observations, selected with due regard to the ordinary course of variation of the element in question, is adopted as a provisional diurnal mean value of that element.

Uniformity in the hours of observation has long been observed at all but one or two independent observatories. These hours are 10 A.M., 4 P.M.; and 6 P.M., for the rainfall and maximum thermometers. At some stations, it was found, in 1875, that it was the practice to observe Madras or Railway time; and in the Punjab, more especially, this time differs by nearly half an hour from the true local time. The practice was corrected as soon as it was discovered, and the attention of superintendents was emphatically called to the importance of observing local time, and to the enforcement of punctuality on the part of the observers. In this latter respect there was formerly great laxity at some stations; and even now I should not be prepared to assert that all observers are duly mindful of their duties in this matter. But there has been great improvement, and both superintendents and observers show more appreciation of the work and its requirements, keep their instruments in better order, and generally display a more intelligent interest in meteorological registration than was common in earlier years. Indeed the improvement in the character of the registers is largely due to the exertions of the superintendents, many of whom devote much attention to the observatories under their charge, notwithstanding the numerous demands which their other duties make on their time; and among the most assiduous and successful in this respect, are some of those who, holding the medical charge of large civil stations, central jails, &c., have the most onerous duties.

(*f*).—The elevation of the observatories above sea-level (the accurate determination of which is indispensable to the utilisation of the barometric readings, for showing the distribution of the atmospheric pressure and for the preparation of weather charts), is now known with a degree of exactitude beyond that attained in many European countries. For this, we are primarily indebted to the splendid operations of the Great Trigonometrical Survey under General J. T. Walker. Many of the important stations of Northern India have now been connected by spirit-levelling with the line of levels, which has been carried from Kurrachee, up the Indus valley, to the Punjab, and thence down the Gangetic valley to the sea. In the peninsula, some lines of levels have also been carried out, and the elevations of the barometers have been referred to these wherever practicable; but the majority have been referred to data afforded by the bench-marks of the Great Trigonometrical Survey, measured with the theodolite, or to the Railway levels. In all these cases, the barometer has been connected with the local datum level by a line of spirit-level readings.

'A few errors which had crept into these determinations, as given in the first volume of the annual reports, were brought to light by the inconsistency of the reduced baro-

metric readings of the stations affected by them; in these cases, the line has been re-surveyed, and the errors of the original determination discovered and eliminated.

(*g*).—A knowledge of the geographical position of the stations and of the local peculiarities of the sites of the observatories is to be gained only by personally visiting them. I have myself visited sixty-one of the present stations, many of which have also been inspected by the local Meteorological Reporters; and of the remainder, twenty-five have been visited by the local Reporters for Bengal, the North-Western Provinces, and Western India, who are fully competent to judge of and note the features which would affect the local meteorology and the indications of the instruments, and who have communicated descriptions, abstracts of which have been published in the annual reports. There remain, therefore, twenty-nine stations, including the remote stations in the frontier and other foreign states, and those recently established, which have not yet been visited by any of the above-named officers. Some of these I hope to visit during the present year. The following are lists of the stations visited respectively by myself and the local Reporters, and those yet unvisited:—

A.—Stations visited by the Meteorological Reporter for India.

Agra, N. W.	Darjeeling, B.	Ootacamund.†
Ajmere, N. W.	Dehra, N. W.	Pachmarhi.
Akola, W. I.	Delhi.*	Patna, B.
Akyab.	False Point.	Poona, W. I.
Allahabad, N. W.	Hazaribagh, B.	Port Blair.
Amraoti, W. I.	Hoshangabad.*	Purneah, B.
Bangalore.	Jessore, B.	Rangoon.
Bareilly, N. W.	Jubbulpore.	Ranikhet, N. W.
Bellary.	Khandwa.*	Rawalpindi.
Benares, N. W.	Lahore.	Roorkee, N. W.
Bombay, W. I.	Lucknow, N. W.	Saugor.
Burdwan, B.	Ludhiana.*	Salem.
Berhampore.	Madras.	Saugor Island.
Calcutta, B.	Meerut, N. W.	Secunderabad.
Chanda.	Mooltan.	Seoni.
Chakrata, N. W.	Moulmein.	Sialkot.
Chittagong.	Mussooree, N. W.	Silchar, B.
Coimbatore.	Nagpur.	Simla.*
Cuttack.	Nancowry.	Sutna, N. W.
Dacca, B.	Negapatam.	Trichinopoly.
		Wellington.†

B. denotes that the stations have also been inspected by the Meteorological Reporter for Bengal; N. W., by the Reporter for the North-Western Provinces; and W. I., by the Reporter for Western India. The stations thus marked * were also visited by Mr. Eliot when officiating as Meteorological Reporter for India. Those thus marked † were visited before the establishment of the observatory.

B.—Stations visited by the Meteorological Reporters for Bengal, North-Western Provinces, and Western India only.

Abu, W. I.	Goa, W. I.	Kurrachee, W. I.
Belgaum, W. I.	Goalpara, B.	Malegaon, W. I.
Bickaneer, W. I.	Gorakhpur, N. W.	Neemuch, W. I.
Buldana, W. I.	Gya, B.	Rajkot, W. I.
Bhuj, W. I.	Hyderabad, W. I.	Ratnagiri, W. I.
Chikalda, W. I.	Indore, W. I.	Salaru, W. I.
Deesa, W. I.	Jacobabad, W. I.	Sholapur, W. I.
Durbhanga, B.	Jhansi, N. W.	Surat, W. I.
	Karwar, W. I.	

C.—Stations hitherto unvisited by the above officers.

Bassein.	Mangalore.	Raipur.
Bushire.	Masulipatam.	Sambhar.
Cochin.	Mercara.	Sambalpur.
Dera Ismail Khan.	Mergui.	Sibsagar.
Demagiri.	Murree.	Sironcha.
Diamond Island.	Nowgong.	Sirsa.
Gilgit.	Pachpudra.	Thull.
Khatmandu.	Peshawar.	Thyet Mio.
Leh.	Quetta.	Tounghoo.
Madura.		Vizagapatam.

Of these last, two are in Bengal and Assam, five in Burma, three in the Central Provinces, five in the Punjab, two in Rajputana, six in Madras, one in Central India, and five in frontier and other foreign states.

Possibly, some of the Madras stations in this and the first list may have been visited by the Meteorological Reporter for Madras; but of this I have no information, in the absence of reports.

(*h*).—In order to determine corrections for reducing the crude means of the observations to true mean diurnal values, or, what is the same thing, in order to determine the diurnal variations of the several meteorological elements, it was provided in the original scheme that, at nineteen stations, hourly observations should be recorded on four days in each month. At four of these stations (in Bengal and Assam), such registers had been kept regularly for one or two years; and at four others (in Bombay), they had been recorded on one day in each month for 22 years. At these latter stations three sets of hourly observations monthly have been recorded since February 1878. The system of four sets of hourly observations has been introduced at all the remaining stations originally proposed (excepting two in Madras, at which nothing has been done), and also at Leh and at the two observatories of Allahabad and Lahore; these last will shortly be raised to the character of first class observatories. The dates from which these hourly observations have been recorded at the several stations are as follows:—

Belgaum	...	...	January 1857.[1] / February 1878.
Poona	...	...	June 1856.[1] / February 1878.
Deesa	...	...	June 1856.[1] / February 1878.
Kurrachee	...	...	June 1856.[1] / February 1878.

Hazaribagh	...	January 1873.	
Patna	...	May	„
Goalpara	...	July	„
Sibsagar	...	January 1874.	
Roorkee	...	March 1875.	
Jubbulpore	...	April	„
Agra	...	April	„
Pachmarhi	...	May	„
Nagpur	...	May 1875.	
Allahabad	...	May	„
Lahore	...	July	„
Lucknow	...	November 1875.	
Chittagong	...	January 1876.	
Cuttack	...	January	„
Rangoon	...	April	„
Leh	...	August	„

The diurnal variations of the principal meteorological elements at the three presidency towns—Calcutta, Bombay, and Madras—are now well known, from the results of the hourly observations, that have been recorded at the three Government observatories, during

[1] The first of these dates is that from which the hourly observations on a single day in each month were commenced, the second that from which three sets of observations monthly have been recorded. The former series is very incomplete for Deesa, and somewhat so in the case of the other stations.

periods of 22, 20, and 26 years respectively; and have been in great part published either *in extenso*, or as monthly abstracts. General Boileau's observations of three years, recorded hourly at Simla, have also been published; and the results up to 1872, of the four Bombay stations which stand first on the above list, have also been published, in abstract, by Mr. C. Chambers, in his volume on the Meteorology of the Bombay Presidency. The publications of the Meteorological Office, presently to be noticed, contain discussions of the hourly barometric observations of Calcutta, Simla, and Hazaribagh (for three years), and others are in course of preparation. When these are completed, we shall have the means of reducing the daily observations of the majority of the stations to truer daily values, than those at present provisionally adopted.

Continuous registration of the pressure, temperature, hygrometric condition, wind direction and movement, and the rainfall, by means of autographic instruments, has been carried on at Bombay since January 1871 and at Calcutta since 1877; and Van Rysselberghe's meteorographs have lately been received from England for Allahabad and Lahore. Autographic registration of the wind by means of Beckley's and Casella's anemographs is now carried on at the following stations, having been commenced at the dates respectively noted as follows:—

Madras	...	(date unknown.)
Bombay	...	June 1867.
Calcutta	...	January 1874.
Rangoon	...	May 1878.
Lucknow	...	17th January 1879.
Deesa	...	16th January ,,
Poona	...	10th June ,,
Roorkee	...	31st August ,,
Chittagong	...	20th June 1879.
Cuttack	...	10th April ,,
Saugor Island	...	10th February 1880.
Hazaribagh	...	April 1880.

3. The work of first class Observatories.

(*i*).—In the scheme of re-organisation, it was proposed to establish first class observatories, provided with instruments registering autographically and continuously, (or at short intervals) at Allahabad and Lahore, as well as at Calcutta and Bombay; and meteorographs on Van Rysselberghe's system were ordered, for this purpose, in 1876. Owing to unforeseen and, in a great measure, unexplained delays on the part of the manufacturer, these instruments have now only just been received in India; and meantime, the site, which was at one time allotted for the new observatory at Allahabad, has been otherwise disposed of. At the present moment, the establishment of the new observatory seems to be postponed to an indefinite future. The arrangements at Lahore are equally *in embryo*. The present site of the observatory is unfitted for the self-recording instruments, and there may be a further difficulty, inasmuch as the use of the meteorograph demands, on the part of the superintendent, some practical experience in the use and control of delicate physical apparatus; and such persons are few in the provinces of India. That these difficulties will be overcome I do not doubt; but I think it probable that there will be a delay of many months before the new instruments can be brought into use. Meanwhile, at both these observatories, observations are recorded four times daily (at intervals of six hours, day and night), instead of during the daytime only; and hourly observations on four days in each month, as at second class stations.

Observations of a special character, including those for experimental purposes, have been carried on to some extent at Calcutta and Allahabad. At the former, the readings of a full set of thermometers and a hygrometer, under strictly comparable conditions, have been made at elevations of 4 feet and 40 feet above the ground surface, three times daily, since March 1878. A series of observations of the nocturnal radiation temperatures of three thermometers, variously exposed, was also carried on from March 1878 to June 1879, and registers of the ground temperatures at the surface, at 1 foot and 3 feet deep, have been kept three times daily since March 1878. A similar register of the ground temperatures has also lately been commenced at Allahabad. Samples of air taken from different depths in the ground, for the purpose of estimating the carbonic dioxide, has been made weekly, at the observatories of Calcutta, Allahabad, Lucknow, Lahore, and some other stations, for the Sanitary Officer; and recently, the observatories of Calcutta and Allahabad have been provided with nephescopes on the principle of that in use at the Montsouris observatory; having been designed by myself and constructed at the Government mathematical instrument workshops. If these are found to answer the desired purpose, which is more especially to observe the movements of the high *cirrus* clouds, they will be furnished to some other observatories.

I have already referred to the comparison that has been made of the hygrometric state of the air as indicated by the psychrometer (dry and wet bulb thermometers) and by Regnault's hygrometer. The latter instrument shows, by direct experiment, the temperature at which air begins to deposit its vapour as dew or cloud; the former shows the temperature of the air and that of an evaporating surface, and from these data the dew point is found by calculation; for which purpose, formulæ have been given by Regnault, Apjohn, and Glaisher. But the results obtained by these several formulæ are never identical, and for extremely dry states of the atmosphere they differ by several degrees. It was therefore important to ascertain the relative validity of the different methods of computation, and also that of the method of observation, which, at best, is only indirect; although, owing to its simplicity and convenience, it is now universally followed. The enquiry could be made, in a satisfactory manner, only at stations in the interior, and during the dry season; and I therefore availed myself of the opportunities afforded by two tours of inspection in 1875 and 1876, to carry with me a verified Regnault's hygrometer, and also a pair of verified thermometers (dry and wet bulbs). The experiments were in most cases made under the thermometer sheds, thus affording a test of the conditions under which the temperature and humidity are ordinarily registered at our Indian observatories. And, as a final result of observations made at several stations in the North-Western Provinces, the Punjab, and the Dakhan plateau, as well as at some stations with a damper climate, it was found that, provided there is a light wind blowing over the psychrometer, its readings, when reduced by Regnault's method, give a close approximation to the true hygrometric condition of the air, even when the dew point is 40° below the temperature of the air. In a still atmosphere, the psychrometer appears always to show too high a degree of humidity. This last result is in accordance with the experiments of Regnault, and the observations of Orlebar and others.

Lastly, during the past year, observations on the solar radiation have been commenced, at the Alipore observatory, with an improved actinometer invented by Professor Balfour Stewart. The instrument is extremely simple, and can be used after a short training by the native observers. The present method of observation is to receive the

sun's rays, concentrated by a lens, during two minutes' exposure, at apparent noon; and also two hours before and after; and to note the rise of temperature thus produced in a thermometer, having a very large bulb, which is enclosed in a massive brass chamber, duly screened from the radiation of surrounding objects. I have been in correspondence with Professor Balfour Stewart on the question of the proper method of reduction; but, at present, it appears that it will be necessary to obtain a somewhat prolonged series of observations, before this question can be satisfactorily determined. The observations, hitherto made, show a great variability on days apparently cloudless, which I am inclined to attribute to variations in the light film of indefinite cirro stratus, or perhaps haze, which is only manifested in the varying tint of the sky. Calcutta, perhaps, is an unfavourable station for the purpose, but I am in hopes that before long we may be able to undertake similar observations at the more favourably-situated station of Leh, the situation of which, 11,500 feet above the sea, should be such as to free us from the obstructive influence of the haze almost universal on the plains of India.

I have already noticed the verification of instruments, which forms an important part of the work of the Alipore observatory, and is also performed by Mr. F. Chambers at Bombay, and by Mr. Pogson at Madras. In the tours of inspection made by the different Reporters, it has always been their practice to verify the barometers at the stations visited, and Mr. Chambers in Western India, and recently Mr. Hill in the North-Western Provinces, and myself in the Central Provinces and Berar have re-verified the thermometers in use at the several observatories inspected, by comparing them at one temperature with a portable standard.

The training of observers was one of the objects proposed in the establishment of the first class observatories; and several of the observers in Western India and the Punjab, and a few in Bengal and the North-Western Provinces, have thus received instruction in their duties. But as the observers at third class stations are for the most part subordinate medical officers, who have other duties to perform, in very many, perhaps a majority of cases, it has not been practicable to carry out the system to the extent desirable. In the absence of such training, it has been sought to meet the requirements of the work, as far as possible, by the issue of a manual, conveying the fullest possible information on the methods of observation, together with concise definite rules, for the guidance of both superintendents and observers; and, further, by issuing a sheet of memoranda on the points requiring prominent attention (and which are found to be most frequently overlooked or neglected), in order that the sheet may be suspended in the office room, and thus kept, constantly before the eye. With superintendents and observers of careful habits these measures, when supplemented by a little correspondence, have proved sufficient to ensure very good work. But with those who are not of this class, no such precautions are of much avail; and I have found observatories, some instances of which will be noticed later on in the report, where the most emphatic directions have been practically ignored; the sheet of memoranda having sometimes been put aside with office papers and lost sight of. In such cases, frequent inspection is the only means of ensuring the observance of the rules.

4.—Measures for the Effectual Supervision of Observatories.

(*l*).—The measures proposed for the more effectual supervision of the work of all observatories were among the first carried out, on the establishment of the general department. A Meteorological Reporter, having no other duties to perform, was appointed

for Western India, to establish and to take charge of the observatories in Bombay, Rajputana, Central India, and Berar; the last in conjunction with the local Sanitary Commissioner. At the same time, the Meteorological Reporter for India undertook the technical charge of all observatories in the Central Provinces, Burma, and the Bay Islands; the local superintendence of which was, and remains, in the hands of the Sanitary Commissioners of the Central Provinces and Burma, and the Principal Medical Officer of the Andaman Settlements. He also undertook the general supervision of several observatories in the frontier and other foreign states, and of some which have been subsequently established, partly as Government, and partly as voluntary observatories in other parts of India. The registers of all these are received in the form of the original observations, the corrections and reductions being carried out in the central office. Each of the local Meteorological Reporters undertakes, in like manner, the primary reductions of the observations recorded at all the observatories under his charge; and thus, all reductions are or should be performed under the immediate superintendence of an officer possessing the requisite technical knowledge.

(*k*).—Before the establishment of the general office, each Meteorological Reporter had the duty of preparing an annual report, discussing the meteorology of his province. This not only entailed a considerable amount of office work, but the result was eminently unsatisfactory; inasmuch as, dealing with only a comparatively small part of the country, the meteorological processes of every part of which are intimately connected and interdependent, it was impossible to discuss the data in a comprehensive and exhaustive manner. Thus, recent experience has shown reason for believing, that the varying accumulation of the winter snows, on the mountain girdle of Northern India, exercises an important influence on the general meteorology of the country; but the meteorological conditions of the mountains were unknown to officers whose field of observation lay in the Central Provinces, Bombay, and Madras, and only partially and imperfectly to those of the northern provinces. Again, the conditions prevalent in the Punjab are of the first importance among the influences affecting the North-Western Provinces, Rajputana, and even Bengal and portions of Western India; but a knowledge of these conditions was inaccessible to the local Reporters of these latter provinces. Indeed, the comprehensive treatment of Indian meteorology demands not only a knowledge of the conditions prevailing over the whole area, up to the crests of the Himalayas, but also of the seas around; and accordingly, steps have recently been taken, by establishing observatories at the Laccadives and Aden, and by collecting for discussion observations recorded by vessels sailing in these seas, to bring the whole area of Indian seas north of the equator within the compass of review.

The change, then, that transferred the duty of discussing the annual meed of data from a number of sporadic offices to one central office, has been, taken singly, perhaps the most important of all the reforms carried out under the new system. On the one hand it has enabled all the data to be condensed in a single annual volume, in which they are reviewed as an organic whole, and are rendered accessible to all; and on the other hand, the local officers and their offices are relieved of much laborious and comparatively unfruitful work, and left more free to undertake discussions and enquiries of a special character. It also enables them to obtain, from the central office, data relating to other provinces, which they may require in the prosecution of such enquiries. They are enabled to inspect their observatories more frequently; and in some provinces, in which there had been

previously little or no inspection, this has been, at all events, partially performed, by the general Reporter and the Reporter for Western India.

In Bombay and the North-Western Provinces, the local Reporters still prepare an annual abstract of the local results, the principal *motif* of which is apparently that of placing in the hands of the local Government and the public an early statement of the local results. But these entail comparatively little labour, and when greater expedition is attained in the publication of the general annual report, they will hardly be required.

5.—Discussion and Publication of the Work.

(*m.*)—Since the observatories were first set on foot, the results of observations made in the several provinces have been in many cases published periodically in the local Government Gazettes, in the form of weekly and monthly abstracts; and this practice is still continued: and, as above noticed, the practice of issuing a brief annual abstract, is still kept up in Bombay and the North-Western Provinces. I have also noticed that the registers of all observatories are collected in the central office, and published partly in abstract (and in the case of six stations in full) in an annual volume, in which the meteorology of each year is discussed in detail, accompanied by tables which show not only the data for the year under report, but also the average values of each element at all stations, derived from all available data up to the date of the volume. Of these annual reports, four volumes have now appeared, *viz.*, those for the four years 1875 to 1878, which have been respectively issued on the following dates:—

Report for 1875 issued on the 14th May 1877.
" " 1676 " " " 28th April 1878.
" " 1877 " " " 3rd March 1879.
" " 1878 " " " 30th August 1880.

The collection, reduction, discussion, and printing of so large a mass of data, forming in each case a thick quarto volume, of necessity requires much time; but I am decidedly of opinion that much greater expedition is not only most desirable, but with proper arrangements quite practicable. The chief causes of delay are—firstly, that the returns of the Madras stations are in great part more than a year in arrears, and secondly, that the printing is unduly slow. In this matter, I would be far from attributing any blame to the Superintendent of the Press, inasmuch as I have every reason to believe he has used such despatch as was possible with the very large amount of work which his establishment has to perform. But at the same time I would certainly wish that greater expedition were feasible. Some improvement was made by Mr. Eliot, in having a portion of the printing of the report of 1877 executed at the Roorkee Press, and this was also done for the report of 1878, which has just appeared. In the case of the volume for 1879, I have sought to accomplish the same end, by distributing over the entire year the printing of that portion of the tables which has hitherto formed Appendix B of the annual volume; and issuing it as a separate publication in monthly parts; and thus, at the same time, achieving an earlier circulation, while the bulk of the annual volume is notably reduced. This, however, is but a slight palliative, and, owing to the joint operation of the two causes I have mentioned, the report for 1878 has been more delayed than any previous volume of the series. If these causes are removed, it should be practicable to commence the printing in June or July, and the report for each year should be ready for issue by November or December at latest.

A measure of scarcely less importance than the collection of the meteorological statistics of India in a single annual volume, has been the establishment of a system of daily report, by telegraph, from fifty (during the monsoon from eighty-four) stations, and the publication of a daily weather report. This was commenced in June 1878 by Mr. J. Eliot, then officiating as Meteorological Reporter to the Government of India, and a system of code telegraphy drawn up by Mr. Eliot and Mr. Pedlar was introduced for the purpose. The reports were printed and issued at Calcutta from the 16th October to the 15th May, and at Simla during the remaining five months. A weather chart, showing the distribution of pressure, temperature, and rainfall, and also the wind directions at 10 A.M., is drawn up daily in the Calcutta or Simla office, the telegraphed reports being entered at once; and the chart is subsequently completed by the addition of the observations of all stations at the same hour, as they are received by post from the non-telegraphing stations. The charts so prepared are filed in the office, and thus a graphic representation of the meteorological conditions all over India and Burma is placed on record, for every day in the year. It has been proposed to publish copies of the preliminary chart (showing the telegraphed data) as a part of the daily report, and a scheme for that purpose was sanctioned in 1878; but the present scientific staff is insufficient to carry out this continuously, and the engagement of a skilled European assistant, which had received the sanction of Government, has been unavoidably deferred for the present owing to financial circumstances.

Even in its present limited form, the system has, however, proved of very great value. It has enabled us to follow and study the changes of the weather, from day to day, in a manner formerly impossible; and the information afforded has at the same time been of much service both to the administration and to the public at large.

In addition to the general system of telegraphic report, a local system under the management of the Meteorological Reporter to the Government of Bengal is in operation at Calcutta, for the purpose of storm warnings. This was originally set on foot in 1865, but it has lately been much improved and extended, and the publication accelerated by Mr. J. Eliot. Reports of the observations recorded at 10 A.M. are now received from fifteen stations around the coasts of the Bay of Bengal, and published, together with a lithographed weather chart, every afternoon. A somewhat similar system, modified to adapt it to the local circumstances of the west coast, has lately been sanctioned for Bombay, to be carried out by the Meteorological Reporter for Western India.

Over and above the more obvious advantages of the daily report system, above briefly alluded to, the method presents one further advantage of the highest importance. It affords the most simple and direct means of controlling the work of the stations. When reduced and placed side by side on a chart, the observations of all stations are directly comparable, and it can be seen at a glance whether they are concordant or otherwise. Any striking inconsistency is at once detected, and a succession of such is irrefragable evidence either of carelessness on the part of an observer, or of the existence of some cause of error, which can then be enquired into, hunted up, and expunged. Any single apparent inconsistency is at once brought to the notice of the superintendent of the station; and thus the existence of a constant system of check is brought home to the consciousness of observers, acting as a very powerful inducement to them, to furnish accurate work.

The activity of the department has not been limited to the mere collection and publication of the immediate results of observation. In a country offering such exceptional advantages for the study of meteorological laws, to have restricted our efforts to the mere collection of the primary statistics, and to have left all ulterior scientific discussion to the chance activity of volunteer students, would have been, to my mind, a blameworthy renunciation of duties, which the peculiar opportunities of our position raise to the character of a privilege. This has been very fully appreciated by some, at least, of the officers who have been associated with me in the work of the department; and already a number of independent reports and memoirs, on special subjects connected with the meteorology of India, have been issued; partly as separate publications by the local Governments, but chiefly as contributions to a serial, the "Indian Meteorological Memoirs," which has been established as a vehicle for the publication of such special treatises. Of the former class the most important are—

Report on the Vizagapatam and Backergunge Cyclones, October 1876. By J. Eliot, M.A., 4to.
Report on the Madras Cyclone of May 1877. By the same, 4to.
Report on the Normal Rainfall of the North-Western Provinces. By S. A. Hill, Esq., B.Sc.

Of the Meteorological Memoirs, a serial in 4to. form, illustrated with plates, four parts have been issued, containing the following papers:—

1st.—The Winds of Calcutta: An analysis of ten years' hourly observations of the wind vane and four years' anemograms. By H. F. Blanford.

2nd.—The Meteorology and Climate of Yarkand and Kashghar: Being a discussion of registers kept by Dr. J. Scully in 1874-75. By H. F. Blanford.

3rd.—The Diurnal Variation of Barometer at Simla. By H. F. Blanford.

4th.—Storms in Bengal during the year 1876, accompanied with increased atmospheric pressure, and the apparent reversal of the normal diurnal oscillation of the barometer. By J. Eliot, M.A.

5th.—On the Rainfall of Benares, considered in relation to the prevailing winds. By S. A. Hill, B.Sc.

6th.—On the Diurnal Variation of the Barometer at Indian stations, Part I, Calcutta and Hazaribagh. By H. F. Blanford.

7th.—Variations of Rainfall in Northern India. By S. A. Hill, B.Sc.

8th.—Meteorological and Hypsometrical observations in Western Thibet, recorded by Dr. J. Scully, with a discussion. By H. F. Blanford.

9th.—The Winds of Kurrachee. By F. Chambers.

In addition to the above, a number of shorter papers on various meteorological subjects have been contributed by the above-named officers to the Journal of the Asiatic Society of Bengal, the Journal of the Austrian Meteorological Society, the Journal of the Meteorological Society of London, the publications of the Royal Society of London, and "Nature."

Finally, I may mention a work, the "Indian Meteorologist's Vade Mecum," in two volumes, 8vo., prepared by myself, for the double purpose of serving as a guide to those who are engaged in carrying on the work of observation, and also of giving to all who are interested in meteorological enquiry a condensed and systematised account of what was known of Indian meteorology and its rational explanation up to the time of the work's appearance. In both respects it has, I believe, answered the purpose of its preparation, and has much facilitated the administrative work of the department.

In the three years that have elapsed since the publication of this work, the progress of knowledge has made it possible to make some additions of importance to the informa-

tion therein given; and the average meteorological conditions of the country at different seasons, which serve as the standard from which those prevailing in any given year may be regarded as variations, must necessarily be ascertained with a continually greater approach to accuracy as the years roll on. But the very cordial reception which the work has met with at the hands of some of the most eminent meteorologists of Europe and America, as testified in critical notices in leading meteorological and other physical publications, is an assurance that, even at the early stage of its development, the systematic study of the meteorology of India has contributed in no small degree to the general advance of the science, and affords an encouraging hope that the continued activity of the officers of the department may, in the course of a few years, lead to results of the highest importance, both from a local and general point of view.

In concluding this preliminary notice of the work of the department during the past five years, I desire to express emphatically how much has been due to the cordial co-operation, more especially of Messrs. Eliot and Hill, the Reporters for Bengal and the North-Western Provinces. From both these officers I have received invariably the most friendly and active assistance; and their own independent work, undertaken and carried on by them amidst many other engrossing duties, has contributed a large proportion of the advance actually made. Mr. Chambers also, in Western India, has organised the observatories under his charge in a manner which is entirely satisfactory; and although his actual contributions to the publications of the department have been less than those of the two officers first mentioned, this has, I believe, been in a measure attributable to the want of sufficient office assistance, which might enable him to undertake original work, requiring much detailed discussion.

To the Sanitary Commissioners of the Central Provinces, Berar, and British Burma, and to the Principal Medical Officer of the Andaman Settlements, I am indebted for much cordial assistance in carrying out improvements in the local observatories, and my acknowledgments are equally due to not a few of the officers, chiefly medical officers, who immediately superintend the observatories.

ADMINISTRATION IN 1879-80.

Having reviewed, in the foregoing pages, the general work of the Department during the last five years, including that which more specially forms the subject of the present report, it remains only to give an account of the operations of the past year from a more detailed point of view; adopting the same classification of subjects as was observed in the report for 1878-79, *viz.*—

OBSERVATORIES.

Bengal and Assam.	Bombay.
North-Western Provinces.	Madras, Mysore, Coorg, and Hyderabad.
Punjab.	British Burma.
Central Provinces.	Bay Islands.
Berar.	Extra Indian.
Central India and Rajputana.	Rain-gauge stations.

METEOROLOGICAL OFFICERS AND OFFICE WORK.

Officers.	Annual report.
Office establishments.	Weather bulletins and other publications.
Daily reports.	

LIBRARY.

OBSERVATORIES.

A list of the observatories which were in operation on the 31st March 1880, and which communicated registers to the Meteorological Office in 1879, has been given at pages 5 to 7 of the introductory portion of this report. From this it appears that, with the addition of one in Ava, which has been for the present abandoned, and one in Bombay, which has also been relinquished, there were 119 observatories of all classes, distributed in the several provinces and foreign states as follows:—

INDIAN EMPIRE.

Bengal and Assam	20
North-Western Provinces and Oudh	14
Punjab	12
Central Provinces	11
Berar	5
Central India and Rajputana Agencies	9
Bombay	15
Madras, Mysore, Coorg, and Hyderabad	16
British Burma	8
Bay Islands	2
	112

FOREIGN STATES.

Ava	1
Nepal	1
Kashmir Territories	2
Baluchistan	1
Persian Gulf	1
Goa	1
	7

This list shows an increase of nine on the number given in the last year's report; *viz.* one each in Bengal, the Punjab, Nepal, and Ava, two in Rajputana, and three in Madras and Coorg. Of the whole number, two are first class observatories, with instruments registering autographically; twenty-one second class observatories, at twenty of which, in addition to observations at 10 h. and 16 h., and synoptic observations at 7 h. 45 m., Washington time (18 h. 36 m., Calcutta time), observations are registered hourly on four (or in some cases three) days in each month; and the remainder, with two exceptions, third class stations, registering two full sets of observations (in the case of the Madras stations three sets) daily. At the two excepted stations, which rank as fourth class stations, the observations are less numerous in kind. They may be otherwise classified as—

Government observatories with paid observers under the Meteorological Department	102
Observatories at Government Offices; observers not paid by the Meteorological Department	15
Private and foreign observatories	2

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character, and is immediately superintended by the Reporter to the Government of India. Up to December 1879, the work carried on here was restricted to meteorological observations, and the establishment was in the temporary charge of the 1st Photographic Assistant, Babu Khettra Mohun Mookerjee. But on the 5th December, the operations connected with the determination of the local time, and the working of the time-ball on the Semaphore Tower in Fort William, were transferred to Alipore, and Babu Brojo Mohun Rakhit, who, on the death of Babu Haran Chunder Mookerjee, had been appointed chief observer, but up to the above date had carried on the time-ball work at the Surveyor General's Office, assumed charge of the observatory and of the full duties of his appointment. This change has been followed by a considerable improvement in the character of the work, which for some time previously had shown some indications of laxity and inexperience.

Previously to his promotion to the post of chief observer, Babu Brojo Mohun Rakhit had served as Head Computer for about six years in the Meteorological Office, and the careful and accurate character of his work in this capacity, no less than his general intelligence, had shown him to be well qualified for his present more responsible appointment.

There was no interruption of the time-ball operations on the occasion of their transfer from the Surveyor General's Office in Park Street to Alipore. The telegraph line had been set up many months previously, and I myself had adjusted the transit to the meridian by observations of the pole-star, verified by the transit of zenith stars. It only remained to alter the connections of the telegraphic line and to transfer the astronomical clocks, which, not having been cleaned for some years, were sent to Messrs. Hanhart & Co. for that purpose; the work, meanwhile, being carried on with a battery of chronometers.

During the first few weeks, there were several interruptions to the regularity of the time-ball, arising in one or two cases from the insufficiency of the battery power, with the increased length of telegraph wire, and the sluggishness of the trigger of the old time-ball apparatus; in another instance, from an accidental contact of the communications; and in a fourth from an accident to the line wire in the fort, which was broken by the fall of a gun, which was being hoisted in its vicinity; since these little difficulties were remedied, the work has been carried on with great regularity.

The new time-ball apparatus, an invention of Mr. Varley, was received from England in April, and not therefore until after the close of the year under report; and further details respecting it may therefore be deferred for the report of the current year.

The meteorological work of the observatory has been carried on as described in the report for 1878-79. The difficulties met with in the working of the photographic processes at high temperatures have been so far overcome, that the traces obtained in the hot season, although not free from fogging, are distinct and measurable; and accordingly, a bi-hourly register of the barometric, thermometric, and hygrometric elements is now taken from the traces. These can, if necessary, be made hourly, or be otherwise amplified from the traces.

The observations of the air temperature and humidity, under strictly comparable conditions, at elevations of 4 feet and 40 feet above the ground, three times daily, have been continued, and two years' registers are now on record.

The observations of ground temperatures at the surface, at 1 foot and 3 feet deep, have also been continued; but it was found, on taking up the thermometer at 1 foot deep in February last, for the purpose of re-verifying it, that, at some time, which cannot be certainly determined, but was probably at or soon after the date of its being fixed in position (in May 1878), the outer tube had been fractured, and the scale slightly displaced. The error thus arising must have been constant, and probably affects all the readings of the instrument; but its amount cannot be accurately ascertained. In the act of removing the indurated earth around the instrument, the extremely thin tube, which alone remained uninjured, snapped, destroying the instrument. The observations recorded with it suffice to show the diurnal and annual range, but their absolute value is doubtful to about half a degree. On the 1st April, a verified thermometer, mounted in the same manner as that at 3 feet deep, was inserted at 1 foot deep to replace the broken instrument; and the observations have since been carried on regularly. The following is a register of the mean temperature, in each of the 20 months, during which these observations have been recorded at equal intervals of eight hours; and I add, for comparison, the mean shade temperatures recorded under the thatched shed close by, at 4 feet above the ground. I omit the registers at 1 foot deep, as being not strictly comparable:—

Months.	Surface.			3 feet deep.			Means.		
	5½ hours.	13½ hours.	21½ hours.	5½ hours.	13½ hours.	21½ hours.	Air in shade.	Ground surface.	3 feet deep.
June 1878	83·4	102·5	83·7	89·0	89·0	89·1	85·7	89·9	89·0
July „	81·3	92·8	82·7	87·1	87·2	87·1	82·6	85·6	87·1
August „	80·5	92·0	82·3	85·8	85·8	85·8	81·9	84·9	85·8
September „	80·6	92·5	82·3	86·4	86·4	86·3	81·9	85·1	86·4
October „	76·9	92·3	79·1	85·3	85·4	85·4	80·3	82·8	85·4
November „	68·4	88·0	70·6	81·7	81·9	81·7	74·0	75·7	81·8
December „	57·8	79·7	60·8	76·1	76·3	76·3	65·7	66·1	76·2
January 1879	53·9	78·8	57·2	72·3	72·4	72·4	65·0	63·3	72·4
February „	61·7	93·7	66·0	74·4	74·5	74·5	71·7	73·8	74·5
March „	69·5	117·5	74·5	79·7	79·9	79·9	79·1	87·2	79·8
April „	78·8	127·0	83·3	86·2	86·3	86·4	85·2	96·4	86·3
May „	82·4	117·9	85·1	90·1	90·2	90·2	85·2	95·1	90·2
June „	81·4	98·3	82·9	87·5	87·8	87·6	82·8	87·7	87·6
July „	80·5	94·7	81·9	86·2	86·2	86·2	81·2	85·7	86·2
August „	81·1	92·7	82·8	86·5	86·5	86·5	80·9	85·5	86·5
September „	81·0	91·8	82·4	86·1	86·1	86·1	81·2	85·1	86·1
October „	77·3	91·4	79·1	85·5	85·5	85·5	79·5	82·6	85·5
November „	65·2	80·5	68·1	80·6	80·8	80·7	70·9	71·3	80·7
December „	56·7	73·4	60·2	74·5	74·8	74·8	64·2	63·4	74·7
January 1880	57·2	74·6	60·1	72·4	72·7	72·6	65·8	64·0	72·6
February „	62·4	81·8	65·9	74·5	74·8	74·8	69·9	70·0	74·7
March „	70·1	101·4	74·2	78·2	78·3	78·4	78·6	81·9	78·3

The interest of these registers of ground temperature is very great, in their bearing on physical meteorology and climate; and they have also a very practical importance with reference to agriculture. They show how the sun's heat is stored up in the superficial stratum of the earth, whence by slow degrees it is imparted to the superincumbent atmosphere. On the average of the two years (counting the means of the months of April and May twice) the mean excess of the ground temperature at 3 feet deep is not less than 5° over that of the air 4 feet above the ground, which at Calcutta is most frequently in passage from the sea, about 60 miles distant.

These are, I believe, with the possible exception of the late Mr. Broun's observations at Trevandrum, the first observations of the kind that have hitherto been made in India. Ground temperatures have indeed been recorded at the Colaba observatory for some years past, and have been discussed by Mr. C. Chambers in his volume on the "Meteorology of the Bombay Presidency," but they have been made with unverified thermometers, and, as appears from Mr. Chambers' description, in shaded ground, so that they do not show facts of the same kind as the observations at Alipore. Observations under similar conditions have recently been commenced at Allahabad, and as they are easily made, and the apparatus is inexpensive, it is my intention to extend them to some other stations in the interior of the country, where there are trustworthy observers.

The actinometer, which had been constructed for the observatory by Messrs. Casella, under the superintendence of Professor Balfour Stewart, was brought into use in November last. It consists of a mercurial thermometer with a very large bulb (about one inch in diameter), and the bulb is enclosed in a massive chamber of brass, surrounded by a layer of felt, and with an outer casing of polished brass, admission being given through a small hole, to a sheaf of the solar rays, concentrated by a lens of one foot focus. The observation consists in allowing this concentrated beam to fall on the bulb for the space of two minutes, and noticing the rise thereby produced in the thermometer. Observations are made on clear days three times daily, *viz.*, at apparent noon, and two hours before and after. The best mode of reducing these observations is now under consideration, and upon this point, I have communicated with Professor Balfour Stewart. It is hoped that the observations will afford a far more accurate measurement of the solar heat than has hitherto been obtained in India; but it is doubtful whether Calcutta is well fitted for them: considerable variations are found to affect the registers, on comparing the observations of days when the sky is free from visible masses of cloud; variations which appear to depend on the varying tint of the sky. It is well known that, during the dry season, the Calcutta sky is characteristically of a pale tint, due in all probability to a uniform sheet of transparent cloud matter at a great elevation; and partly perhaps to the haze, which is more or less dense at all times of the year, and especially so in the dry season. Were competent observers available, it is probable that, either mountain stations or small insular stations would be better fitted for actinometric work; and it is to be hoped that, before long, it may be undertaken at a station of the former class, *viz.* Leh, which has been recommended for the purpose by the Committee of the Royal Society, now sitting in London, for the purpose of promoting observations on solar physics. One of Balfour Stewart's actinometers has been ordered for this purpose, and it is expected shortly. When received, it will be compared with the instrument in use at Alipore, and then forwarded to Leh, where Mr. Ney Elias, the gold medallist of the Royal Geographical Society, will undertake the observations.

Another class of observations which are of high importance, in which, hitherto, but little has been done, is that of the movement of the clouds, more especially the elevated cirrus; since this shows the movements of wind currents at great elevations, which are sometimes very different from those affecting the lower atmosphere. When in Calcutta during the last cold season, I designed a simple form of nephescope, very similar to that in use at the Montsouris Observatory near Paris, and two of these instruments were constructed at the Mathematical Instrument Department. One of these has been set up at Alipore, the other at Allahabad, but they were not completed until about the end of the year under report.

An apparatus for the purpose of verifying barometers at low pressures, similar to that in use at Kew, consisting of a cast-iron vacuum chamber, with an air pump for exhaustion, and containing a standard barometer, was received from England during my absence at Simla last year, and on my return to Calcutta was unpacked and set up at the observatory. I made some trials with it, but, owing to a defect, the seat of which I have not yet been able to discover, there is a slight leakage, which prevents its satisfactory working. It is not sufficient to prevent its use for the purpose for which it is intended, and some verifications have been made with it; but in the present condition of the apparatus I should not feel confidence in any work not carried out in my own presence.

The following is a list of the instruments verified at the observatory from the 1st April 1879 to the 31st March 1880:—

Barometers	55
Dry and wet bulb thermometers	34
Maximum thermometers for air temperatures	31
Minimum ditto ditto ditto	36
Ditto ditto for nocturnal radiation	31
Solar radiation thermometers	33
Standard thermometers	4
Boiling point thermometers	2
TOTAL ...	226

The following is a summary of the instruments received and issued:—

	Received.	Issued.
Barometers	21	37
Dry and wet bulb thermometers	27	46
Maximum thermometers for air temperatures ...	15	33
Minimum ditto ditto ditto ...	24	40
Ditto ditto for noctural radiation ...	76	49
Standard thermometers	2	3
Solar radiation thermometers	49	36
Boiling point thermometers	2	2
Anemographs	...	4
Anemometers	7	20
Rain-gauges	6	6
	180	240

These include the instruments issued for the equipment of new observatories, as well as those furnished to replace injured and broken instruments. The Alipore Observatory is

now practically the depôt from which all observatories are supplied. Deducting the instruments issued to new observatories, the issues show that the average number of instruments worn out, injured, or destroyed, including those injured in carriage, amounts to something less than two for each observatory in the year. Of these, fully one-third are the thermometers for nocturnal and solar radiation, which are necessarily much more exposed to injury than other instruments. In future reports, I shall endeavour to give a return showing the number of new instruments supplied to each observatory, which will afford some criterion of the degree of carefulness shown by each observer. I am, however, able to say that the injuries to a very large number of the instruments put out of use arise from causes not attributable to carelessness. Such are, for instance, the leakage of barometers, the faulty action of some maximum and minimum thermometers, and the wearing out of the gearing of anemometers. The actual expenditure of barometers (the most expensive of the instruments in ordinary use) is extremely small, as the repairs required to render them serviceable can generally be executed at the Mathematical Instrument Department; and the annual indents for instruments, omitting those new in kind which are introduced at some of the principal observatories, are now reduced to a very small figure.

Other Observatories in Bengal and Assam.—There were, during the past year, seven observatories of the second class, ten of the third class, and two of the fourth class in Bengal and Assam, *viz.*—

Second Class.

Sibsagar.	Hazaribagh.	Cuttack.
Goalpara.	Saugor Island.	Chittagong.
Patna.		

Third Class.

Darjeeling.	Berhampore.	Silchar.
Purneah.	Burdwan.	False Point.
Durbhanga.	Dacca.	Jessore.
Gya.		

Fourth Class.

Demagiri. Mongpoo.

At the stations of the second class, excepting Saugor Island, hourly observations are recorded on four days in each month, and synoptic observations at 18 hours 36 minutes, Calcutta mean time, in addition to full sets of observations of pressure, temperature, humidity, wind direction and movement, cloud proportion, and weather, at 10 hours and 16 hours daily; and the readings of maximum and minimum thermometers, solar and nocturnal radiation, and rainfall, once daily. At Saugor Island, hourly and synoptic observations are not taken, but all instruments are read also at 4 hours and 22 hours. At third class stations, the hourly and synoptic observations are also not recorded, but in other respects the work is the same as at the majority of the second class stations. At those of the fourth class, only temperature and rainfall are registered. The Mongpoo Observatory is situated at the Government cinchona garden below Darjeeling, and the register is kept by the Curator, Mr. Gammie, the thermometers having been verified at Alipore. This register appears for the first time in the report for 1878.

A list of the superintendents and observers is given in Mr. Eliot's report in Appendix A.

The only change of importance in the work of some of the observatories, during the past year, has been the introduction of anemographs for the purpose of obtaining continuous registers of the wind. Anemographs, either of Beckley's or Casella's construction, have been furnished to all the second class observatories excepting Sibsagar; but, as special arrangements have to be made for setting them up, they were actually brought into use at only three of the observatories during the past year, *viz.* as follows:—

Cuttack, from 10th April 1879.
Chittagong, from 20th June 1879.
Saugor Island from 10th February 1880.

At Hazaribagh, a small building has been erected for the anemograph, and was completed and the instruments were set up on it at the end of the year. At Patna and Goalpara, some delay has been incurred, owing to the proposed removal of the observatories at these stations: in the former case to another building at Bankipore, (a question which awaits the decision of the Meteorological Reporter to the Government of Bengal); in the latter case to another station, *viz.* Dhubri, to which the civil establishment of Goalpara has been removed, thus necessitating the removal of the observatory. This change is so far advantageous that Dhubri is much more accessible than Goalpara, and the new observatory will be more readily inspected by the Meteorological Reporter. It is also better, as being nearer the hill station of Darjeeling; with which, therefore, it affords a better comparison. It is, however, always a matter of regret that the site of an observatory should be changed, since the accumulated registers of former years no longer serve as a standard of comparison; and it is only to be permitted when, as in the present case, it is practically unavoidable. The removal of the observatory from Goalpara to a station lying further to the west, leaves moreover the whole of the Assam valley unrepresented, as far up as Sibsagar, and renders it highly desirable to establish an additional station in the interval; preferably at Gauhati. I trust therefore that it will be practicable to establish a third class observatory at Gauhati when the removal of the Goalpara observatory to Dhubri shall have been accomplished.

Mr. Eliot's report shows that the working of all the stations appears to be satisfactory; and that, with rare exceptions, the observations furnished by them are accurate and trustworthy; and he attributes the recent improvement, to the rapid transmission of the morning observation daily, by post or telegraph, and the continuous check which is thus afforded by the daily comparison of the observations at all stations.

Five of the observatories were inspected by Mr. Eliot during the year, *viz.* Darjeeling, Purneah, Gya, Durbhanga, and Burdwan. He reports that the position of the Darjeeling Observatory (at the Electric Telegraph office) is open to some objections; but, having regard to the much stronger objections which attach to any removal of the instruments, considers that if arrangements can be made for erecting the wind vane and anemometer on some exposed position on the summit of the ridge, Darjeeling will be one of the most useful and valuable of the hill stations. Indeed in many respects it is so already, the observations being very carefully recorded, and extending over a much longer period than those of any other hill station in India. Some further remarks on the third class observatories are given in Mr. Eliot's report in the appendix.

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH.—In the North-Western Provinces, there were, as in the previous year, four observatories of the second class (or working as such,) and ten of the third class, two of which, *viz.* the St. Fidelio Observatory and that of the Surveyor General's Office, both at Mussooree, communicate their registers direct to the Calcutta office, and are not noticed in Mr. Hill's report (Appendix B). On the other hand, two of the observatories enumerated in Mr. Hill's report are in Rajputana and Central India.

Second Class.

Allahabad.	Lucknow.
Agra.	Roorkee.

Third Class.

Chakrata.	Mussooree (S. G.'s. Office).	Gorakhpur.
Ranikhet.	Meerut.	Benares.
Dehra.	Bareilly.	Jhansi.
Mussooree (St. Fidelio).		

Allahabad, which, it is hoped, will shortly be established (as originally intended) as a first class observatory, at present furnishes a more complete register than other second class stations, inasmuch as observations are recorded daily at four equal intervals of 6 hours, instead of at 10 hours and 16 hours only. It is to be regretted that the prospect of removing the observatory to a permanent and far superior site in the Alfred Park has been annulled by the appropriation of the allotted building to other purposes ; and it would almost seem that, now that the long-expected meteorograph for this observatory has arrived in India, its setting up must be indefinitely deferred, owing to the want of a suitable place for the observatory. The disadvantages of the present site are, as pointed out by Mr. Hill, that the wind observations are of very little value, and it may be added that, being a private dwelling house, and not a public building, it may, at any time, be necessary to remove the instruments. The meteorograph for Allahabad will be kept in Calcutta until a suitable building is assigned for the observatory.

A simple form of barograph (Milne's), which marks the height of the barometer hourly on a sheet of metallic paper, has been brought into use at Allahabad experimentally, in anticipation of the meteorograph. It was set in action in February last, and has worked well. The register requires, however, a correction for temperature, which can only be approximately determined.

Two Beckley's anemographs were supplied to Lucknow and Roorkee, and a Casella's anemograph to Agra. That at Lucknow has worked regularly throughout the year, but Mr. Hill considers that there is some impediment or undue friction, which prevents its showing the full velocity of the wind. That at Roorkee has been carefully set up by Dr. Murray Thomson, and has worked very well. The traces were commenced in August 1879. The Casella's anemograph could not be set up at Agra, as there was no suitable place for it. It has therefore been transferred to Sutna in Baghalkand.

In addition to the Allahabad observatory, which is under Mr. Hill's immediate superintendence, the observatories at Agra, Meerut, Chakrata, Roorkee, Dehra, Benares, and Lucknow were inspected by Mr. Hill during the year. He also visited the two

private observatories at Mussooree. All the observatories were found to be in good order, except that the barometer at St. Fidelio had met with an accident, which much impaired its readings. Another barometer which was sent up to replace it was also injured; and recently this also has been replaced from Calcutta, the injured instruments being returned for repair.

During his tour of inspection, Mr. Hill re-verified the barometers in use at Agra, Meerut, Roorkee, Dehra, Benares, Lucknow, and Chakrata, and found the corrections, which had been previously determined, practically identical with those afforded by his comparison; except in the case of the last two stations, where a somewhat larger error was found—larger at Chakrata than at Lucknow. As the original comparison of the Chakrata instrument had been made only at the Calcutta pressure, while the actual readings are taken at 7,000 feet above sea level, this difference may possibly be due to a scale error either in the Chakrata instrument or the mountain barometer which Mr. Hill carried with him; a point which cannot at present be determined.

He also re-verified the thermometers in use at Allahabad, Benares, and Lucknow; and found that, in all cases, a small rise had taken place in the scale values. As will presently be mentioned, I found the same in the case of the thermometers in use in the Central Provinces, but I am not certain that the difference noticed is really due to a change in the instrument. It is probably due in part to an error of the Kew standard, with which the thermometers were originally verified in 1875 and 1876, and which in the beginning of 1879 was found to have undergone a rise in its scale values of 0·4°. Allowance has been made for this in all subsequent determinations.

With respect to the registers furnished by the stations in the North-Western Provinces, Mr. Hill reports that they have a high character for accuracy, and considers that the observations are fairly and honestly taken. With reference to a remark in his report of last year, impugning the work of the observer at the Roorkee observatory, Mr. Hill observes in his present report: "Dr. Murray Thomson has succeeded in showing, I think, that my condemnation of some of the hourly observations at Roorkee in last year's report was too hasty, and that in some cases, at least, very surprising coincidences among the observations of consecutive hours do really occur. He deserves every commendation for the way in which he has taken up and enquired into this matter."

OBSERVATORIES IN THE PUNJAB.—Of these, there are now twelve in all, one additional observatory having been established at Thull during the past year. With the exception of Lahore, all are observatories of the third class. At Lahore, which it is intended to establish as a first class station, the work is carried on in the same manner as at Allahabad, and it ranks at present as a second class station. The following is a list of the stations:—

Second Class.

Lahore.

Third Class.

Mooltan.	Rawalpindi.	Simla.
Dehra Ismail Khan.	Sialkot.	Delhi.
Thull.	Murree.	Sirsa.
Peshawar.	Ludhiana.	

The Thull observatory reports direct to the central office at Calcutta. The Simla observatory up to the end of the year under report was an independent observatory,

being attached to the office of the Quartermaster General; and the observations being recorded by a non-commissioned officer employed on the establishment. The remaining observatories are under the control of the Meteorological Reporter to the Government of the Punjab, whose report is given in Appendix C, together with a nominal list of the superintendents and observers. The report is less detailed and comprehensive than those of the Reporters for Bengal and the North-Western Provinces, and notices the condition and work of only three observatories, *viz.* Lahore, Ludhiana, and Delhi. The first is stated to have been satisfactorily conducted. The two others, which were inspected by Dr. Lawrie after his appointment to the Reportership in October 1879, had been carried on with some laxity. Attention had been drawn by myself to the doubtful character of the observations at Ludhiana in December 1879, and these were found on inspection to have been recorded by a man appointed temporarily to the duty, during the absence on deputation of the regular observer. At Delhi, it was found that the Assistant Surgeon in charge had been in the habit of deputing his duties to compounders and servants of the hospital, and as Dr. Lawrie had reason to suspect that the practice was common among observers generally at the Punjab stations, a circular was issued directing that, in future, all observations should be accompanied by a certificate, to the effect that the observer himself had taken them.

The Simla observatory was visited by myself, and the instruments found to be in excellent order. With the exception noticed in last year's report, *viz.* the omission of observations on Sundays and holidays (an omission which has been remedied from the beginning of the year now current), the work of this observatory has been very regular.

It is intended to establish the Lahore observatory as an observatory of the first class, and the meteorograph ordered for it has now been received. But, as in the case of Allahabad, the present site of the observatory is unfitted for the purpose, and there are other difficulties to be overcome before the observatory can be properly established in the manner proposed. This subject will have my attention during the present year.

OBSERVATORIES IN THE CENTRAL PROVINCES.—These are eleven in number, as in the previous year, *viz.* three stations of the second class, and eight third class stations.

Second Class.

Nagpur.	Jubbulpore.	Pachmarhi.

Third Class.

Saugor.	Chanda.
Seoni.	Sironcha.
Hoshangabad.	Raipur.
Khandwa.	Sambalpur.

The names of the superintendents and observers are given in Appendix D. These observatories are under the local direction of the Sanitary Commissioner to the Government of the Central Provinces, all technical matters being in the charge of the Meteorological Reporter for India. During the past year, I made a tour of inspection through the Central Provinces, visiting Jubbulpore, Hoshangabad, Pachmarhi, Saugor, Seoni, Nagpur, Chanda, and Khandwa. Of these, Saugor, Seoni, Pachmarhi, and Chanda were visited for the first time. I carried with me a verified barometer and standard thermometer, and verified all the barometers and thermometers in use at the several observatories visited; excepting that an accident to the portable barometer, on the road to Chanda, having

rendered it unserviceable, the verification of the barometers at this station and Khandwa could not be accomplished.

At Jubbulpore and Nagpur, all the instruments were in excellent order, and the work appears to be carefully performed. The wind vanes and anemometers at both stations are too near the ground, although the position is well exposed; but these will shortly be replaced by anemographs. For this instrument, at Jubbulpore, Dr. Rice hopes to utilise thet ower of the municipal hospital, which will afford an admirable position, raising it above all obstacles. For that at Nagpur it will be necessary to raise the low round tower on which the present anemometer is set up, and to provide a small room for the recording cylinder and clock. The instruments have lately been forwarded to the two stations, and it is hoped that they may be brought into operation during the present year.

The Hoshangabad observatory was satisfactory in most of the arrangements, but the barometer had been improperly suspended, and the position of the wind vane was unsatisfactory.

At Pachmarhi, the barometer had been set up in the thermometer shed, and the minimum wet bulb thermometer was found to have a drop of spirit representing 6.3° of the scale lodged in the upper end of the tube. The wind vane and anemometer also were too near the ground to be of much service.

At Saugor, the barometric readings had for some time appeared to be unduly high. On visiting the station, the explanation was at once apparent. The barometer had been removed from the building in which it was formerly kept, to another building, half a mile off, and at a level some 60 feet lower; and the removal never having been reported, a permanent change had been made in the value of the readings, of which no intimation had been given. Here also, the wind vane and anemometer were set up too near the ground. The instruments were found to be in good condition, but the thermometers were suspended on a board instead of in a cage of the usual pattern, and in a shed enclosed with louvres, instead of one open at the sides. The sun thermometer also was improperly placed, being 8 feet above the ground.

At Seoni, the position selected for the observatory is good, but the condition of some of the instruments was less satisfactory than at most of the stations visited, and in some respects showed that but little attention had been paid to the printed instructions. The barometer was so dirty, and hung in so bad a light, that any accurate reading of it was impossible; and being rigidly fixed, and not vertical, and moreover too high for the observer, the barometric register hitherto kept must be regarded as giving at best but an approximation to the truth. The hygrometer had never been removed from the box in which it was packed;[1] and as it appears to have been frequently kept closed, an explanation is afforded of the apparently high humidity which the Seoni registers have sometimes shown. The remaining instruments were found to be in good condition.

The Chanda observatory was in very good order, with the exception, that the anemometer had been fixed on the top of a post, so rotten that it could not be ascended for the purpose of reading the instrument; and it was the observer's practice to read the dial from the ground. Moreover it appeared, on trial, that he did not know how to read it properly. An erroneous practice in the manner of reporting the barometer was discovered

[1] Some London makers issue dry and wet bulb thermometers screwed in a small flat box, which also contains the water cup. It is intended apparently to serve as a cage, and is perforated by one or two holes to give admission to air. Such an arrangement in an Indian atmosphere is rather a vapour bath than a meteorological instrument.

and corrected. It was found to be the observer's practice, in direct opposition to the printed instructions, to apply the correction of the instrument before entering the reading in his register; and as the correction was again applied in reducing the readings, these were made to appear unduly high.

The inspection of the observatories of Saugor, Pachmarhi, Seoni, and Chanda yielded many proofs of the insufficiency of merely printed directions, however specific and concise, to ensure proper methods of work. At all these observatories, practices which are noticed and emphatically condemned in the printed instructions, were found to be in vogue. On the other hand, at observatories that had been inspected before, such as Hoshangabad and Khandwa, the practice was found to be generally correct. The only objectionable arrangement at the last-named station is that here, as at Saugor, the barometer is in a building at a distance of about half a mile from the other instruments.

In Appendix E is given more in detail the results of the inspection of these observatories.

OBSERVATORIES IN BERAR.—There are five of these, one, *viz.* Makhla, being established in connection with the Forest Department, and working as a fourth class observatory. They are:—

Third Class.

Akola.	Chikalda.
Buldana.	Amraoti.

Fourth Class.

Makhla.

The names of the superintendents and observers at the four departmental observatories are given in the table in Mr. Chambers' report (Appendix F).

Two of the Berar observatories, *viz.* Amraoti and Akola, were inspected by myself during the year, and the thermometers were verified at one temperature by comparison with a secondary standard which I carried with me. The barometers were not compared, as my portable secondary standard had been broken by the rough treatment it received during my journey on a native bullock cart (a *ringi*) between Warora and Chanda. The observatories were found to be in good order, except that the wind vanes at both stations were worn out and useless, and a somewhat primitive appliance, in the shape of a piece of rag held in the observer's hand at Amraoti and fastened to a post at Akola, is used as a substitute. Moreover, the scale of the barometer at Amraoti was almost illegible, owing to an escape of mercury, and the instrument was not quite vertical.

The elevations, formerly determined, of the barometers at Amraoti and Buldana having been found to be erroneous by the comparison of the barometric readings with those of Akola and other stations, they are re-determined during the year, by lines of spirit-levels to the nearest railway stations of the Great Indian Peninsula Railway. The values now ascertained appear to be fairly correct.

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—Of these there are now nine; two, *viz.* Ajmere and Sutna, being under the direction of the Meteorological Reporter for the North-Western Provinces and Oudh; three, *viz.* Sambhar, Pachbudra, and Nowgong, communicating their registers to my own office; and the remainder under the Meteorological Reporter for Western India. They are as follows:—

Third Class.

Sutna.	Indore.	Ajmere.
Nowgong.	Mount Abu.	Sambhar.
Neemuch.	Pachbudra.	Bickaneer

Nowgong and Sambhar are established on the voluntary system; the observations at the former being recorded at the Rajcoomar College under the superintendence of the Principal, and those at the latter by the Salt Agent, the observatory having been established by the kindly volunteered assistance of the Salt Commissioner, Mr. Halsey. That at Pachbudra was also originally established on the same system, but as a sanctioned observatory in the same part of Rajputana, *viz.* Jessulmere, had remained in abeyance, the allowance was transferred to Pachbudra, which now forms a regular observatory of the department.

The observatory at Sutna has been inspected both by Mr. Hill and myself during the year: by the former in June 1879, and by myself in February of the present year. On both occasions the instruments were found to be in excellent condition, and all the arrangements satisfactory. On re-verifying the instruments, one of the minimum thermometers was found to have a large error, and it has been replaced by another instrument. Those of the other thermometers were very small, not exceeding two or three tenths of a degree.

The Ajmere observatory, which was unfavourably reported on in the report for last year, has been removed to a new and much better site near the Kacheri, where the instruments were established at the beginning of the present year. The removal has been carefully carried out by the superintendent, Dr. Newman, who has had the difference of elevations carefully determined.

Of the remaining observatories in these provinces, Indore and Neemuch were inspected by Mr. F. Chambers, and Bickaneer by Surgeon-Major G. S. Sutherland, the Superintendent General of Dispensaries in Rajputana. The Indore observatory was found to be satisfactory in all respects; and that at Neemuch also, excepting that the anemometer was much worn, and had to be replaced by a new instrument; which was put up under Mr. Chambers' supervision.

The Bickaneer observatory was less satisfactory. The thermometer shed was found to be badly constructed, and with too thin a roof. Moreover the cistern level of the barometer had never been adjusted, and the instrument was exposed in the thermometer shed; affording another instance of the neglect of the printed instructions which is too frequently shown at stations that have not been formally inspected. The barometric readings of this station have therefore hitherto been erroneous, and it remains to be seen whether it will be now practicable to determine a correction which may bring them approximately to true values.

Up to last year, the elevation of this observatory had been determined only by a comparison of the barometric readings with those of other stations in Rajputana, the Punjab, Sind, and Gujrat, and, as results from the discovery made by Dr. Sutherland, it is necessarily erroneous. During the last year, the operations of the Topographical Survey in Rajputana have furnished a more trustworthy datum, and the level of the observatory has been referred thereto by the kind assistance of Colonel G. C. Depree. The elevation originally adopted is thus found to be about 61 feet in error.

The names of the superintendents and observers at the majority of the observatories are given in the reports of Mr. Hill and Mr. Chambers in Appendices B and F.

OBSERVATORIES IN THE BOMBAY PRESIDENCY.—During the greater part of the year under report, the number of observatories in Bombay was the same as that given in last year's report, *viz.* fifteen; but one of those established on the voluntary system

at Salaru was suppressed in March of the present year, on the removal of the observer to Hyderabad; where an observatory already exists. The following is a complete list:—

First Class.

Bombay (Colaba).

Second Class.

Belgaum.	Deesa.
Poona.	Kurrachee.

Third Class.

Jacobabad.	Rajkot.	Ratnagiri.
Hyderabad.	Surat.	Karwar.
Salaru.	Sholapur.	Malegaon.
Bhuj.		

The Colaba observatory is independent of the department, only furnishing a register of such of the observations as are required for discussion and publication in the daily and annual reports. The observations of Karwar and Salaru are furnished by volunteers, and are reduced and corrected in my own office. Those of the remaining stations are dealt with by the Meteorological Reporter for Western India.

Mr. Chambers' report (Appendix F) shows that the observatories at Poona and Deesa have been removed to new sites; and that what is virtually a new observatory has been established at Belgaum, although the situation has not been altered. At Deesa, observations were continued at the old observatory for a year, *viz.* up to October 1879, in order to furnish a comparison of the average values of the elements at the former and present sites; and similar precautions are being taken at Poona.

Mr. Chambers has inspected the observatories at Poona, Sholapur, Karwar, Belgaum, and Ratnagiri. With respect to Poona, he reports that everything connected with the observatory was remarkably neat and orderly, and that the same may be said of the observer's work, which has a high character for accuracy. He notices some defects in the working of the Casella's anemograph; but although there is no question that the instrument is less effective than the much more expensive anemograph of Beckley, the defects noticed are not of such importance as seriously to detract from the value of the instrument, when the registered results are intelligently dealt with. In this matter, I think Mr. Chambers' condemnation is much too sweeping. Judging from the working of similar instruments at stations in Bengal, which certainly do not present more favourable conditions than Poona, I am convinced that the registers have much value, even granting that a very small portion may have to be rejected, as affording doubtful indications.

At Sholapur, most of the instruments were found to be in good order, and at Karwar everything was in perfect order. At Belgaum, the old wind vane was found to be one or two points in error, but with this exception everything was in good order; and at Ratnagiri, the only point calling for remark was that the thatch of the thermometer shed was in some places not so thick as is desirable.

On his tour of inspection Mr. Chambers re-verified the barometers and thermometers in use, with the satisfactory results given in the table in his report, in the appendix.

The names of the superintendents and observers are also given in his report.

OBSERVATORIES IN MADRAS, MYSORE, AND HYDERABAD.—There are now sixteen observatories in these provinces; three, *viz.* Ootacamund, Mercara, and Mangalore,

having been added during the past year. One of these, *viz.* Ootacamund, is on the voluntary system, the instruments having been furnished by this office, and the registers being kept by an assistant of the Executive Engineer, Major Morant, R.E. The other two stations have been established on the same system as the third class observatories in other provinces, the instruments being set up at the local Telegraph Offices, and the observations at 10 hours and 16 hours being recorded by the Electric Telegraph Masters, and communicated direct to the Calcutta office for reduction. The whole cost of these two observatories, including that of establishment for the reduction of the observations, has been covered by the allowance originally sanctioned for a single observatory on the Madras system at Mangalore. Vizagapatam is a private observatory, the property of Mr. A. V. Nursingrow, who, for many years past has freely communicated his registers to the Calcutta office, as well as a daily telegram of the observations at 10 A.M. The remaining observatories, which rank as third class, differ from those in other parts of India, first, in contributing one additional set of observations daily, *viz.* at 22 hours (10 P.M.), and, secondly, in drawing an allowance of Rs. 40 per month for the observers instead of Rs. 15. The following is a list of the stations :—

Third Class.

Madras.	Salem.	Bangalore.
Madura.	Trichinopoly.	Bellary.
Coimbatore.	Negapatam.	Secunderabad.
Wellington.	Cochin.	Masulipatam.
Ootacamund.	Mangalore.	Mercara.

Second Class. (*Private.*)

Vizagapatam.

It was proposed on the re-organisation of the system in 1875, that Bellary and Trichinopoly should be established as second class stations; but this has never been carried out. The establishment of the three new stations above mentioned, has been accomplished by this office, so that the number of stations dealt with by the Meteorological Reporter for Madras remains the same as in previous years. I regret to say that since the publication of the last report there has been no improvement in point of expedition, in the communication to this office of the registers of the stations under the Meteorological Reporter; and they are now as much in arrear as at any previous time. Those of Madura for the whole of the year 1878, and those of Wellington for five months of the year, have never reached me; and after long delay, it has been necessary to issue the report for 1878 with the tables for these stations left wholly or partially blank. One station, Wellington, has for the last two or three years furnished returns so defective (or untrustworthy ?) that I am of opinion that, now that an observatory has been established in regular working in Ootacamund, it would be desirable to suppress the Wellington observatory, and to transfer a portion of the allowance to the observer at Ootacamund, whose work is quite satisfactory.

The work at the remaining stations appears to be satisfactory, but, in the absence of any report from the Meteorological Reporter for Madras, I am unable to give any details. In one or two cases, as at Madura and Secunderabad, observatories have been deficient in certain essential instruments for many months; owing, I believe, to there having been none available at Madras. Whenever such cases have come to the knowledge of this office, they have been immediately supplied.

Since, under the present system, the local Meteorological Reporters, with the exception of the officer for Western India, are officially independent of this office, it has not been possible for me to interfere more actively than I have done in the administration of the Madras observatories. The great inconvenience, the delay and imperfections in the data which have been experienced, have frequently been the subject of representation to Government, both in former annual reports and in special correspondence; and although in some cases the present system of Reporterships works admirably, and I have no desire to modify it, I think that in others some modification is desirable, and I shall offer some recommendations on this head in a subsequent part of this report.

OBSERVATORIES IN BRITISH BURMA.—Of the eight observatories in British Burma, one, Akyab, has always been under the direction of the Meteorological Reporter to the Government of Bengal, and is enumerated with the Bengal stations in his report. Another, Diamond Island, was established for the special purpose of storm warnings, and sends a daily telegram also to the Bengal Office; but the registers, as well as those of the remaining Burmese stations, are dealt with in my own office. The six remaining stations are under the immediate direction of the Sanitary Commissioner of British Burma, the technical details being arranged in my office, as is the case with the registers of the Central Provinces. The following is a list of the stations:—

Second Class.

Rangoon. „

Third Class.

Bassein.	Tounghoo.
Diamond Island.	Moulmein.
Akyab.	Mergui.
Thyet Myo.	

The observatories have all worked satisfactorily, as far as can be judged from the registers sent in. As, however, only two of these have ever been inspected by myself, no definite opinion can be pronounced on their condition, and it is very desirable that they should be visited as speedily as possible.

A list of the superintendents and observers is given in Appendix G.

OBSERVATORIES IN THE BAY ISLANDS.—These two observatories are directed locally by the chief medical officer of the Andaman Settlements, the registers being transmitted to my office. They are:—

Third Class.

Port Blair.	Nancowry. „

The registers during the past year have been satisfactory. The elevation of the Nancowry barometer has been determined more accurately, and was found to differ by 3 feet from that adopted since the removal of the instrument to the local hospital.

EXTRA INDIAN OBSERVATORIES.—During a portion or the whole of last year registers were received from the following observatories:—

Second Class.

Leh. (Ladák.)

Third Class.

Mandalay (Ava).	Khatmandu (Nepal)
Quetta (Beluchistan).	Gilgit (Kashmir).

Bushire (Persian Gulf).

Fourth Class.

Jellalabad (Afghanistan.)
Peiwar Kotal (Ditto .)
Kurram Fort (Ditto .)

and also from one foreign observatory, *viz.* Goa, the Director of which, Señor Antonio Martins, also transmits a daily telegram for inclusion in the Weather Report.

Of the above, Mandalay was necessarily abandoned on the withdrawal of the mission in October 1879, and the three observatories in Afghanistan on the withdrawal of the forces after the first occupation of the country in July last. The remainder were in full operation at the close of the year, and preparations were made to establish observatories also at Amini Devi in the Laccadive Islands, at Aden, and Zanzibar, full sets of verified instruments having been furnished for the purpose from this office for Aden and Amini Devi, and from Bombay for Zanzibur.

The Gilgit observatory has been admirably superintended by Dr. Scully, and that at Leh by Mr. Ney Elias. The Khatmandu observatory was established in October 1879 by the Resident, Mr. Girdlestone, under the voluntary system, and has contributed very valuable registers. I have also received from Mr. Girdlestone a register of temperature and rainfall at Khatmandu extending back to the year 1851.

The Bushire observatory is also on the voluntary system under the direction of the Resident, Colonel Ross. The Quetta observations are recorded by the Telegraph Master under the superintendence of the medical officer, Dr. G. Thomson ; and this observatory and that of Mandalay, which was established by the late regretted Resident, Mr. R. B. Shaw, had paid observers. All the registers of these stations have been of a satisfactory character, and it is much to be regretted that the Mandalay observatory has unavoidably been abandoned.

Wide as is the area represented by these stations and those previously enumerated in the territories of British India, it does not comprise the whole region from which meteorological registers are received and discussed in the annual reports. The island of Ceylon in which a system of meteorological observation has been carried on for some years under the direction of Colonel A. B. Fyers, R.E., communicates a monthly abstract of the observations, from which a selection is made for the tabular abstract given in the annual report; and I have lately also included an abstract of the rainfall registers communicated to me from Singapore. Thus the extreme geographical range of the region for which meteorological data were collected for discussion during the past year comprises 53 degrees of longitude (from Bushire, in east longitude 50° 20′, to Singapore, east longitude 103° 40′) and 33 degrees of latitude (Gilgit to Singapore).

RAIN-GAUGE STATIONS.—The stations which record rainfall only, communicate their registers to the Meteorological Reporters of Bengal, the North-Western Provinces, and Madras; and the returns are published by them weekly or monthly in the local Gazettes. In other provinces, they are either under the Revenue Boards or the Sanitary Commissioners, and the returns are in most cases published in a similar manner. From the whole, a selection has been made, chiefly those of the sudder stations, or the seats of Political Agencies, numbering 240 in all, and these are given in abstract in the annual reports, in conjunction with the rainfall returns of the meteorological observatories. During the last year an improvement in the transmission of these registers was carried out under the orders of the Government of India, so that, instead of being received through

the local Reporters, or being extracted and compiled from the pages of the Provincial Gazettes, the returns of the selected stations are transmitted direct to the Meteorological Office in Calcutta month by month, thus very much facilitating and expediting the preparation of an annual return of the rainfall for the information of the Home Government. The returns hitherto sent in leave certain areas in Western Rajputana and in the eastern part of the peninsula, which are occupied by native states, and which, for the most part, are in the state of desert or wilderness, unrepresented by any rainfall returns. Steps are now being taken to reduce the extent of this unrepresented area, but it is doubtful whether it will be practicable to procure returns from the wild region of Bastár and Jeypore.

Meteorological Officers and Office Work.

Officers.—The general control of meteorological observatories and offices in the different provinces, with the local exceptions noticed in the foregoing section, has been in the hands of the following officers during the past year:—

Province.	Superintending Officer.	Names.
Bengal and Assam	Meteorological Reporter, Government of Bengal	John Eliot, M.A.
North-Western Provinces and Oudh.	Meteorological Reporter, North-Western Provinces and Oudh.	S. A. Hill, B.Sc.
Punjab	Meteorological Reporter, Punjab	Surgeon-Major A Neil. Surgeon-Major T. E. B. Brown. Mr. Oman. Surgeon E. Lawrie.
Central Provinces	Sanitary Commissioner	Dr. J. Brake.
	Meteorological Reporter, Government of India ...	H. F. Blanford, F.R.S.
Berar	Sanitary Commissioner	Dr. Abbott.
	Meteorological Reporter for Western India ...	F. Chambers.
Central India and Rajputana	Meteorological Reporter, North-Western Provinces and Oudh.[1]	S. A. Hill, B.Sc.
	Meteorological Reporter for Western India ...	F. Chambers.
Bombay	Ditto ditto ditto ...	Ditto.
Madras	Meteorological Reporter, Government of Madras	N. R. Pogson, F.R.S.
Burma	Meteorological Reporter, Government of Bengal[2]	John Eliot, M.A.
	Sanitary Commissioner	Dr. Kelly.
	Meteorological Reporter, Government of India ...	H. F. Blanford.
Bay Islands	Senior Medical Officer, Port Blair	Dr. J. Reid.
	Meteorological Reporter, Government of India ...	H. F. Blanford.
Extra Indian Observatories	Meteorological Reporter, Government of Punjab†	Surgeon-Major A. Neil. Surgeon-Major T. E. B. Brown. Mr. Oman. Surgeon E. Lawrie.
	Meteorological Reporter, Government of India ...	H. F. Blanford.

[1] Two stations. [2] One station.

The Government Astronomer, Mr. N. R. Pogson, has on more than one occasion desired to be relieved of the meteorological work which he performs as Meteorological Reporter to the Government of Madras. I have, in former reports, spoken in high terms of the excellent arrangements which in this capacity Mr. Pogson had made in establishing the observatories in Southern India; but, at the same time, I have been obliged to comment on the inconvenience and delays which the work of this office has suffered, owing to the great retardation in the communication of the work of those observatories to my own office. In the last two years, these delays have become such that, however much I may regret the loss of Mr. Pogson's valuable assistance, I have been obliged to recommend that Mr. Pogson's wishes in the above respect should be acceded to, and either that I should be allowed to take the Madras observatories under my own charge, or that their direction should be placed in the hands of some qualified officer whose other avocations allow of his devoting more time to the work. This recommendation has received the approval of the Government of India, but as the appointment is in the hands of the Madras Government, the subject has been referred to that Government, and I have not learnt what arrangements it has been decided to make.

In June of last year, the sudden and lamented death of Dr. Neil, who had held the post of Meteorological Reporter to the Government of Punjab from the formation of the department in 1865, left a vacancy in that appointment. For a few months the duties of the office were carried on by Surgeon-Major T. E. B. Brown, and Mr. Oman, a Professor of the Lahore College. In October, Surgeon E. Lawrie, Professor of Anatomy, was appointed to the Reportership, and has since carried on the work.

With the exception of the Meteorological Reporter for Western India, who receives his appointment from the Government of India, the local Reporters are officially independent of this office, and receive their appointments from the local Governments. This is a matter of no practical importance in many cases. Such officers as Mr. Eliot, Mr. Hill, and the late Mr. W. G. Willson take part as cordially and harmoniously in the general work of the department as could possibly be desired, and as could be secured under any system whatever. They are trained physicists, and having a thorough appreciation of the requirements of the work, they are enabled to keep their observatories well up to the required standard, and to take a large share in working up the results of the system to scientific conclusions. But officers of this class are not always available on the spot for the Meteorological Reporterships; and under such circumstances, the provincial system of Meteorological Reporterships is not unattended with some disadvantages. An officer who has had no special training as a physicist, however distinguished he may be in other branches of work, is hardly in a position to give much real assistance in meteorological work, to superintend the training of observers, to detect errors of method and practice, and to superintend experimental enquiries in the observatory under his immediate direction; and, above all, he is unable to bear any part in the scientific discussion of the results. Indeed it is easy to see that, in certain cases, such an officer holding a meteorological appointment may become, unintentionally, rather an impediment than an assistance. I think, then, that in selecting and appointing officers as local Meteorological Reporters, the Meteorological Reporter to the Government of India, who has to deal with the whole work of the department, should at least be consulted; and, further, that in case a technically qualified officer is not locally available, a departure from the strictly provincial system should be permitted. With a proportional addition to their

office establishments, it would be quite practicable for the existing qualified officers of the department to deal in some cases with a larger number of stations which they actually control; and, under the circumstances supposed, this would, I am sure, be preferable, if only as a temporary arrangement, to the obvious alternative.

The registers are in all cases reduced and examined by the several Meteorological Reporters, and they deal with those of the following number of stations in each case, situated as shown in the following table:—

Provinces.	Meteorological Reporters.						Total.
	India.	Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	
Bengal and Assam	2	18	...	...	...	...	20
North-Western Provinces and Oudh	2	...	12	...	...	...	14
Punjab	1	...	...	11	...	...	12
Rajputana and Central India ...	3	...	2	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay	2[1]	...	...	...	12	...	14
Madras, Mysore, &c.	3	...	...	...	...	12	15
Burma	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	6[2]	...	...	1	...	...	7
Total ...	40	19	14	12	20	12	117

This list does not include the registers of the Colaba observatory, of Goa, and Vizagapatam, which are furnished to the Meteorological Office with all the necessary reductions.

In Bengal, the North-Western Provinces, and Madras, the Meteorological Reporters superintend also the numerous rainfall registers of the district and sub-divisional stations of their respective provinces, and prepare weekly returns of the rainfall; and in Bengal, the Reporter has also charge of a system of daily reports received by telegraph from fifteen stations, and published in connection with the system of storm signals for the protection of the port of Calcutta.

Office Establishments.—The following table exhibits the number of employés in the offices of the several Meteorological Reporters, as far as information has been received, up to the end of the year under report. For Madras, information is wanting.

	India.	Bengal.	North-Western Provinces.	Punjab.	Western India.
Head Clerk	1	3	1	1	1
Computers	2	...	...	...	1
Clerks and copyists	2	2	3	1	3
Tabulators	12	3			
Draftsmen	2	...	...	...	...
Peons and menials	6	2	1	1	1

[1] Including one abolished in March.
[2] Including one now suspended.
[3] The Head Clerk of the India Office also acts in the same capacity for the Bengal Office.

The offices of the Reporters for India and Bengal have been, as in former years, under the management of Babu Fanindra Mohun Basu, and with the same very satisfactory results. Mr. Hill reports that his Head Clerk, Babu Chintamony Ghosh, has done as much with his present small staff as could be done, and has deprived himself of many holidays to which he was entitled in order to carry on the work. The increase of salary, which Mr. Hill considers that he has merited, has been sanctioned from the beginning of the year now current.

The insufficiency of the office establishments to execute with despatch the constantly-increasing current work, and at the same time to assist in working up the accumulated data for the purpose of scientific discussion, is noticed by more than one of the Reporters. The Reporter for the Punjab received some additional assistance during the past year, and an additional clerk has been sanctioned for the office of the Reporter to the Government of the North-Western Provinces from the beginning of the present year. Some additions have also been made to the offices of the Reporters for Bengal and Bombay, and others are now under consideration.

WEATHER BULLETINS AND OTHER PUBLICATIONS.—The publications of the office may be noticed under the heads of—

Daily and weekly reports.
Annual reports.
Other publications.

Daily and weekly Reports.—The system of daily weather reports has been continued as described in the Administration Report for last year, except that, during the rainy season, reports are received by telegraph from eighty-four instead of fifty stations only. This extension was made during the last rainy season, with a view to furnishing the Government with more complete information on the distribution and progress of the rains. The additional service is in operation from the 16th June to the 15th October, and in the case of a few stations in Madras till the 30th November. The daily report was issued at Simla from the 26th May to the 15th October, and at Calcutta during the remainder of the year. The Simla issues give a short verbal description of the condition and changes of the weather, in addition to the tabulated data; but these are not issued at Calcutta, nor would it be practicable to give this uninterruptedly, unless a scientific assistant is provided. Neither can the weather chart, which is drawn up every day for office use, be published without similar assistance.

The storm warning system, administered by the Meteorological Reporter to the Government of Bengal, has been carried on during the past year in the same manner as in former years. Preparations were made for improving and extending this system, by increasing the number of telegraphing stations from seven to fifteen, by accelerating the transmission of the reports and the publication of the daily bulletins; so that the latter should be printed and issued on the afternoon of the day of report, not only to the port authorities and the newspaper offices, but also to merchants and others interested; and also by adding to the bulletin a rough chart, showing the state of the weather around the coasts of the Bay, at 10 A.M. of the day of report. These preparations were completed by the 31st March, and the first issue under the new system took place on the 1st April 1880.

The storm signals were not hoisted during the year. The beginning and end of the the summer monsoon were marked by several small cyclonic storms, one of which visited

Madras coast in May, and after crossing the peninsula was severely felt on the Bombay coast; two or three on the Orissa coast in September, and one on the coast of Arakan near Cox's Bazar in October. These, however, did not affect the mouth of the Hooghly sufficiently to necessitate the exhibition of the storm signals.

A scheme for establishing a somewhat similar system of daily bulletins and storm warnings for the coasts of Bombay, was under consideration during the past year; and some proposals for the purpose were drawn up by Mr. F. Chambers. The number of telegraphing stations proposed was, however, much larger than that which experience shows to be of any probable utility for the purpose in view, and the scheme as sanctioned was restricted to telegraphing stations on the coasts, the Reporter for Western India being at the same time empowered to call for additional reports, in the event of stormy weather, from such stations as may appear desirable. This scheme was sanctioned after the close of the year under report.

The Reporters for Bengal, the North-Western Provinces and Bombay published monthly summaries of the meteorological observations of all observatories in their respective provinces, and weekly, and in the case of Bengal, monthly reports of the rainfall at all rain-gauge stations. At the beginning of the year 1880, an improvement in the form of the Bengal rainfall reports was introduced by Mr. Eliot, by publishing in the *Calcutta Gazette* a monthly return of the daily rainfall. At the same time the weekly summaries of the telegraphed observations and of the rainfall was discontinued as unnecessary.

A weekly and monthly abstract of the observations recorded at the Alipore observatory is published in the *Calcutta Gazette*.

Annual Reports.—The report on the meteorology of the year 1878 was completed, and the whole in the printer's hands before the middle of February, having been much delayed by the non-receipt of the Madras registers, which had not only retarded the writing of the report, but also necessitated keeping many sheets standing in type for many months, while awaiting the completion of the tables. Eventually, it was resolved that, it was not desirable to incur further indefinite delay, although the returns for two stations were wholly or partially wanting; and the report has therefore been issued with these deficiencies. Owing to the further delay in printing, it was not finally completed for issue till the 30th August 1880.

The report gives tables of temperature for 116 stations, and rainfall returns of 353 stations, being an increase of eight of the former and forty-one of the latter on those given in the report of the preceding year. The stations affording registers of pressure, wind direction, and other meteorological elements are nearly as numerous as those of temperature. The elements tabulated in the appendices are as follows:—

	Stations.
Equilibrium temperature of solar radiation	99
Temperature of nocturnal radiation	97
Mean and extreme air temperatures	116
Sea-level equivalents of mean temperature	100
Atmospheric pressure	113
Sea-level equivalents of atmospheric pressure	96
Wind direction and movement	113
Temperature of evaporation	106
Tension of atmospheric vapour	113
Mean relative humidity of the air	114
Mean proportion of clouded sky	110
Inches of rainfall in each month of 1878	353
Number of days in which rainfall was measured in 1878 ...	276

The descriptive letter-press discusses the meteorology of the year in detail, and gives a final summary. It includes twenty-two numbered tables, giving the average values of the more important elements, at all stations that have yielded registers for three years and upwards; and the report is illustrated with seven plates, one of which is a chart showing the position of all observatories and rain-gauge stations, and is now given for the first time.

A second appendix gives the detailed observations at six stations, *viz.* Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras.

Mr. Hill has also published, independently, an annual summary of the observations of the observatories in the North-Western Provinces and others which he superintends; and Mr. F. Chambers has issued a similar summary of the data of the stations under his administration.

Other publications.—Part 3 of volume I of the Indian Meteorological Memoirs was issued during the year, containing a paper by Mr. S. A. Hill on cyclical variations of the rainfall of Northern India; and one, by myself, discussing Dr. J. Scully's observations in Western Tibet. A paper by Mr. Chambers (the first which he has contributed to the Memoirs) on the "Winds of Kurrachee" was received during the year, and at the close of the year was nearly ready for issue, as Part 4 of the Memoirs.

A very valuable report of Mr. Hill's on the normal rainfall of the North-Western Provinces was printed by the local Government, and does not therefore form part of the departmental publications. It gives a very valuable summary of the rainfall data of past years, at 246 stations in the North-Western Provinces, and 29 stations in adjoining provinces; and is illustrated by charts, showing the normal distribution of the annual, winter, and summer rainfall.

One or two short papers have been contributed by myself to the Journal of the Asiatic Society of Bengal and "Nature" on the subject of the abnormally high atmospheric pressure of the years 1876-78, and also of a cyclical oscillation of pressure conforming to the sun-spot period, which is manifested by stations in India and the Malay region; most distinctly by insular stations (Singapore and Batavia) near the equator; also of an oscillation of the same period, but having opposite phases, which characterises Western Siberia and Russia, and which in this case is restricted to the winter season. These subjects have also been discussed to some extent in the report for the year 1878.

A comparative return of the rainfall of India in 1879 was prepared and submitted to Government for communication to the Secretary of State on the 7th February 1880.

Appendix H gives a list of institutions, &c., to which the publications of the office are presented, including those which furnish their own publications in exchange.

LIBRARY.

The increase of the library has made it necessary to provide an additional large double book-case, and some further provision will soon be necessary for the volumes of marine observations, relating to Indian seas; one-half of which (January to June) have now been received from the London Meteorological Office. The whole of the library is in excellent order. The additions made during the past year are enumerated in the following list.

Presentations to the Library from the 1st April 1879 to the 31st March 1880.

Place.	Donor.	Title of Work.
Adelaide ...	C. Todd, Esq., Director of the Observatory.	Meteorological observations made at the Adelaide Observatory from June to December 1878.
Algiers ...	Meteorological service ...	Bulletin mensuel; première année, December 1873 to December 1874.
		Deuxiéme année. Tableaux d' Observations, December 1874 to July 1875; also text.
		Bulletin Météorologique du Gouvernment Général de l'Algérie. 5 me Année. Nos. 1138 to 1226 and 1228 to 1562.
		Résumé des Observations, Janvier—Decembre 1879.
		Tableaux des Quantités de pluie, Septembre 1878 à Août 1879.
		Meteorological observations taken at Algiers during 1876, 1877, 1878.
Allahabad ...	Government of the North-Western Provinces and Oudh.	Report on the Rainfall of the North-Western Provinces and Oudh.
	Meteorological Office ...	Report on the Administration of the Meteorological Department in the North-Western Provinces and Oudh.
Batavia ...	The Director of the Observatory...	Observations made at the Magnetical and Meteorological Observatory at Batavia, Volumes II and III.
Berlin ...	Dr. Gustavus Hellman ...	Organization of meteorological establishments in the States of Europe.
		Der zweiter Internationaler Meteorologen Congress abgehalten zu Rom in April 1879.
		Plan für ein Meteorologisches Beobachtungsnetz im Dienste der Landwirthschaft des Königreichs Preussen.
Bombay ...	Government of Bombay ...	Fifteenth Annual Report of the Sanitary Commissioner for the Government of Bombay, 1878.
	Meteorological Office ...	Report on the Administration of the Meteorological Department in Western India for the year 1878-79.
		Brief sketch of the Meteorology of the Bombay Presidency in 1878.
Brussels ...	A. Lancaster, Esq. ...	Discussion des Observations d'orages faites en Belgique pendant l'année 1878.
	Observatoire Royal de Bruxelles	Annales de l'Observatoire Royal de Bruxelles, January to September 1879.
		Meteorological observations at other stations, April to December 1878.
		Catalogue des Ouvrages d'Astronomie et de Météorologie.
		Annuaire, 1878 and 1879.
		Resumé of meteorological observations at all stations, January to June 1879.
Buenos Ayres ...	Meteorological Office ...	Anales de la Oficina Meteorologica Argentina, Volume I.
Calcutta ...	The Revd. E. Francotte, S. J. ...	Results of observations taken at the St. Xavier's College Observatory, from July to December 1878 and January to December 1879.

Presentations to the Library from the 1st April 1879 to the 31st March 1880—continued.

Place.	Donor.	Title of Work.
Calcutta	Geological Survey of India	A Manual of the Geology of India, Parts I and II, with Map.
		Memoirs of the Geological Survey of India, Volume 16, Part I.
	Government of Bengal	Administration Report of Bengal, 1878-79.
		Report on the International Trade of Bengal for 1878-79.
	Government of India, Home, Revenue, and Agricultural Department.	Report of the Meteorological Council of the Royal Society for the period of ten months ending 31st March 1878.
		Codes of the Financial Department, 4th edition.
		Abstract of the Reports of the Surveys and of other Geographical operations in India for 1876-77.
		Greenwich Magnetical and Meteorological Observations for 1872.
		Return of Wrecks and Casualties in Indian Waters for 1878.
		Report on the Forest Administration of British Burma for 1878-79, with observations and orders on it by the Government of India.
		Progress Report of the Forest Administration in the Hyderabad Assigned Districts for 1878-79, with the remarks of the Commissioner of the Hyderabad Assigned Districts and of the Government of India.
		Medico-Topographical Report on Zanzibar.
		Forest Administration Report of the Central Provinces for 1878-79.
		General Report on the Operations of the Survey of India during 1877-78.
		Abstract of the Reports of the Surveys and of other Geographical operations in India for 1877-78.
		Suggestions regarding Forest Administration in Ajmere and Merwara.
		Review of the Forest Administration in the several Provinces under the Government of India for 1878-79.
	Great Trigonometrical Survey of India.	Account of the Operations of the Great Trigonometrical Survey of India, volumes 2, 3, & 4.
	Henry F. Blanford, Esq. ...	Diurnal variation of rainfall frequency at Calcutta.
	Sanitary Commissioner with the Government of India.	Fifteenth Annual Report of the Sanitary Commissioner with the Government of India for 1878.
	Surveyor-General of India ...	General Report on the Operations of the Surveys of India during 1877-78; operations of the Great Trigonometrical Survey of India, Volume 5.
	Surveyor-General's Observatory...	Meteorologiska Jakttagelser i Sverige of Kongl Svenska Vetenskaps-Akademien, volumes 6—16 (1864—1874).
	S. R. Elson, Esq.	The Sailor's Sky Interpreter.
Christiania	Norwegian Meteorol. Institute ...	Jahrbuch, 1874, 1875, and 1876.
	O. A. L. Pihl	On Magnets.
	Th. Kyeruff	Et Stykke Geografi i Norge.

Presentations to the Library from the 1st April 1879 to the 31st March 1880—continued.

Place.	Donor.	Title of Work.
Copenhagen ...	Institut Météorologique Danois ...	Annuaire for 1877, deuxieme partie; and for 1878.
	Instituts Météorologique de Norvegi, de Danemark, et de Suéde.	Bulletin Météorologique du Nord, 1879, February to April, June, July, September to November.
	N. Hoffmeyer	Rapport sur les Cartes synoptiques.
		Distribution de la pression atmosphérique pendant l'hiver sur l'Océan Atlantique Septentrional, et l'influence qui en résulte sur le climat de l'Europe, with plates.
	Royal Academy of Sciences ...	Oversigt, No. 2 of 1878 and Nos. 1 and 2 of 1879.
Edinburgh ...	Scottish Meteorological Society ...	Journal, new series, Nos. 57 to 59.
Greenwich ...	Royal Observatory ...	Greenwich Magnetical and Meteorological Observations, 1876.
		Greenwich Meteorological Reductions, chiefly 1847 to 1873.
Guatemala ...	Instituto Nacional de Guatemala	Memoria presentada al Señor Ministro de Instruccion Publica por el Director del Instituto Nacional de Guatemala.
		Observaciones Meteorologicas, March to September, and November, December 1879.
Hamburg ...	Deutsche Seewarte ...	Monatliche Uebersicht der Witterung, 1876 and 1877.
		Ditto ditto ditto January to December 1878.
		Wetterbericht, Vol. IV, Nos. 1 to 365; Vol. V, Nos. 1 to 60.
	Dr. A. Sprung	Studien über den Wind und seine Beziehungen zum Luftdruck.
Hong-Kong ...	Government of Hong-Kong ...	Meteorological observations taken at the Government Civil Hospital; February to December 1879 and January 1880.
London ...	G. J. Symons, Esq.	Symons' Monthly Meteorological Magazine, March to December 1879, and January, February 1880.
	G. M. Whipple, Esq., B. Sc., F.R.A.S., F.M.S.	Relation existing between the duration of sunshine, the amount of solar radiation, and the temperature indicated by the black bulb thermometer *in vacuo*.
		Relation between the height of the barometer, duration of sunshine, and amount of cloud as observed at the Kew Observatory.
		On the results of comparisons of Goldschmid's Aneroids.
	India Office ...	Abstract of the Reports of the Surveys and of the other Geographical operations in India for 1877-78.
	Kew Committee of the Royal Society.	Report of the Kew Committee of the Royal Society for the year ending 31st October 1879.
	Meteorological Office ...	Weekly Weather Report, Vol. I, Nos. 20, 33, 34, 36, 38, 42, 45, 46; Vol. II, Nos. 1—4 and 9—52; Vol. III, Nos. 1—8.
		Report of the Meteorological Council to the Royal Society for the period of ten months ending 31st March 1878, and for 1872.
		Hourly observations at seven observatories, March to December 1878.
		Meteorological observations at stations of the second order for the year 1877, Part II, July to December.
		Bulletin International de l'Observatoire de Paris for 1878.

Presentations to the Library from the 1st April 1879 to the 31st March 1880—continued.

Place.	Donor.	Title of Work.
London ...	Meteorological Office ...	Report of the Permanent Committee of the First International Congress at Vienna (Meeting at Utrecht, 1878).
		Contributions to our knowledge of the Meteorology of the Arctic Regions, Part I.
		Daily Weather Reports from 1st July to 31st December 1878.
		Report of the Proceedings of the Second International Congress at Rome, 1879.
		Contributions to the Meteorology of the Pacific, No. 3; Lamon or Navigator's Island; by R. H. Scott, Esq.
	Meteorological Society ...	Quarterly Journal, new series, Vol. II, No. 12; Vol. IV, No. 25; Vol. V, Nos. 29—32.
		List of Fellows of the Meteorological Society, 1st May 1879.
	Royal Asiatic Society ...	Journal, new series, Vol. XI, Parts 1 and 2.
	Royal Society	Proceedings, Vol. XXXVIII, Nos. 190—196; Vol. XXXIX, Nos. 197 and 198.
	Society of Arts	Journal, Nos. 1371—1423.
	William Mariott, Esq. ...	Sur le Psychrométre.
Madrid ...	Observatory	Anuario del Observatorio de Madrid, ano XVII, 1879.
Manilla ...	Osservatorio Meteorologico del Ateneo Municipal de Manilla.	Observaciones verificadas durante el año de 1878, January to September 1879.
Mauritius ...	Meteorological Society ...	Monthly Notices, new series, Nos. 10 and 11.
	Royal Alfred Observatory ...	Cyclone of 20th, 21st March 1879; storm warnings.
Melbourne ...	Observatory	Monthly record, November and December 1878, January to October 1879.
		Results of observations taken during 1876, Vol. V.
Mexico ...	Central Meteorological Observatory.	Index and title-page to Tome III of Boletin, July to December 1878.
		Estudio del Terremoto del 17 de Mayo de 1879.
		Determinacion de la longitud del pendulo de Legundos y de gravidad en Mexico.
		Boletin Tome I, Nos. 3, 10, 40, 59—75; Tome II, Nos. 42—44, 55, 62; Tome III, Nos. 53, 79—83; Tome IV, Nos. 3 to 61, 63—157; and Tome V, Nos. 1—6.
		Registro Meteorologico del Observatorio Central del palacio nacional de Mexico 16—30th April and 16—30th June 1877.
Montsouris ...	Observatoire de Montsouris ...	Annuaire for 1880. Bulletin Mensuel; Tomes I—IV and Tome V, No. 56.
Munich ...	Geographical Society ...	Zweiter, Dritter, Vierter, Fünfter, Sechster, und Siebenter Jahresbericht.
	Koniglich Bayerischen Akademie der Wissenschaften.	Abhandlungen der Mathematisch Physicalischen Classe; Band XIII, Abth. II.
		Sitzungsberichte 1878, Heft IV, and 1879, Heft I.
	Professor Dr. Carl Arendts ...	Deutsche Rundschau für Geographie und Statistik, Vol. I, Nos. 1—12; Vol. II, Nos. 1—5.

Presentations to the Library from the 1st April 1879 to the 31st March 1880—continued.

Place.	Donor.	Title of Work.
New York ...	Central Park Observatory ...	Abstract of registers from self-registering instruments, January to November 1879.
		Annual Report of the New York Meteorological Observatory for 1878.
Paris ...	M. F. F. Hébert ...	Étude sur les grands mouvements de l' atmosphère et sur les lois de formation et de translation des tourbillons.
		Discussion des orages de 1876.
	Bureau Central Météorologique de France.	Bulletin International xxiii Année; Nos. 59—128, 136—150, 152—365; xxiv Année Nos. 1—59.
	Société Météorologique de France	Annuaire. Tome xxvii, Bulletin des Séances, feuilles, 1—21.
		Annuaire. Tome xxvii, tableaux météorologiques, feuilles 1—4.
Pekin ...	Director of the Imperial Russian Observatory.	The Climate of Eastern Asia.
Pesaro ...	Osservatorio Meteorico Magnetico di Pesaro.	Curves. March—August 1878, October—March 1879.
Philadelphia ...	Franklin Institute ...	Journal, Nos. 638—650.
Prague ...	K. K. Sternwarte zu Prag ...	Astronomische, Magnetische, und Meteorologische Beobachtungen der K. K. Sternwarte zu Prag, im Jahre 1878.
Rome ...	Professor Constantino Pettie ...	Congresso Internazionale de Meteorologia a Roma.
		Rapports présentés au deuxiéme Congréss Météorologique international de Rome.
		Rapport sur les travaux du deuxiéme Congress International des Météorologistes reunis á Rome du 14, au 22 April 1879. Proces-verbaux et appendices.
Simla ...	Inspector-General of Forests ...	Suggestions regarding Forest Administration in the Hyderabad Assigned Districts.
		Review of the Forest Administration in the several Provinces under the Government of India for the year 1877-78.
		Management and Conservancy of the Berar Forests during 1875-76.
		Progress Report of the Forest Administration in the Hyderabad Assigned Districts for 1876-77, 1877-78, 1878-79.
Singapore ...	Government of the Straits Settlements.	Meteorological Returns for January to December 1878.
St. Petersburg ...	Dr. A. Woeikof ...	Rémarques sur les isobares de Janvier et de Juillet.
	G. Hellman, Central Physical Observatory.	Vergleichung der normal Barometer von St. Petersburg, Dorpat, Helsingfords, Stockholm, und Upsala nebst allgemeinen Bemerkungen über die Reduction des Barometers auf die normal Temperatur.
	M. Rykatschew ...	Die Vertheilung der Winde über dem Baltischen Meere.
		A. Uber die publication der auf Schiffen angestellten Meteorologischen Beobachtungen. B, Uber Meteorologische Telegramme.
	Central Physical Observatory ...	Annalen des Physikalischen Central Observatoriums, 1875 and 1877.
		Repertorium für Meteorologie, Band VI, Heft 1 and 2.

Presentations to the Library from the 1st April 1879 to the 31st March 1880—continued.

Place.	Donor.	Title of Work.
Sydney ...	Government Observatory ...	Results of rain observations made in New South Wales during 1878.
Syracuse ...	Osservatorio di Siracusa ...	Meteorological observations, January to December 1879.
Tasmania ...	Royal Society of Tasmania ...	Papers and Proceedings and Report of the Royal Society of Tasmania for 1877 and 1878.
Tiflis ...	Royal Observatory ...	Materialien zu einer Klimatologie des Kaukasus. Abth. I, Meteor. Beobachtungen Band II, Lieferung 3, Tiflis, 1878.
Turin ...	Osservatorio della regia Universitá de Torino.	Bolletino. Anno xiii, 1878.
		Applicazione dei principii della Meccanica analitica a problemi, Nos. 1—4.
		Effemeride del sole, della luna, e dei principale pianete caledate, per Torino in tempo medio civile di Roma per l'anno 1379.
		Sullo strumento dei passaggi tascabile di steger, e sulle equazioni fondamentali da cui dipende l'uso di esso, e degli strumenti di passagio in generale.
		Sulla determinazione del tempo collo strumento dei passaggi trasportabile.
Upsala ...	Dr. Hildebrand Hildebrandsson et C. A. Rundland.	Prise et débacle des lacs en Suede—Automne 1871—printemps 1877.
		Bulletin météorologique mensuel de l' observatoire de l' Université d' Upsal, Vol. X, 1878; Vol. XI, Nos. 1- 6.
		Sur la classification des nuages.
Utrecht ...	Institut Royal Météorologique des Pays Bas.	Nederlandsch Meteorologisch Jaarboek for 1878, Vol. I.
	M. Suellen	Le Téleméteorograph d'Olland.
Vienna ...	Dr. J. Hann	Zeitschrift. Band xiv, April to December 1879. Band xv, January to March 1880.
		Die tägliche periode der Geschwindigkeit und der Richtung des Windes; Einführung in die Meteorologie der Alpen; Untersuchungen über die Regenverhältnisse von Oesterreich Ungarn.
	Dr. Josef R. Ritter Lorenz von Liburnau.	Bericht für den zweiten Internationaler Meteorologen Congress.
	K. K. Central Anstalt für Meteorologie und Magnetismus.	Internationaler Telegraphischer Wetterbericht. Jahrg. III, Nos. 64—365; Jahrg. IV, Nos. 1—59.
		Jahrbuch Jahrg. 1876. Neue folge. xiii Band.
	K. K. Geologischen Reichsanstalt	Verhandlungen, Nos. 11—18 of 1878, and Nos. 1—4 and 6—9 of 1879.
	Royal Academy of Sciences ...	Anzeiger, Nos. 20—28 of 1877, with index and title-page, and Nos. 1—22 of 1878.
		Boltzmann.—Uber die Beziechung zwischen dem zweiten Hauptsatze der mechanischen Wärmetheorie und der Wahrscheinlichkeits-Rechnung respective den Sätzen über das Wärmegleichgewicht.
		Boué.—Ueber die unterirdischen grossen Wasserläufe und Behälter und die Reinheit sowie Durchsichtigkeit gewisser Seen, dann über die wahrscheinliche Bildung der Seen überhaupt.

Presentations to the Library from the 1st April 1879 to the 31st March 1880—continued.

Place.	Donor.	Title of Work.
Vienna ...	Royal Academy of Science ...	*Finger.*—Ueber den Einfluss der Erdrotation auf die parallel zur sphäroidalen Erdoberfläche in beliebigen Bahnen vor sich gehenden Bewegungen, insbesondere auf die Strömungen der Flüsse und Winde.
		Hann.—Luftdruck zu Wien; Temperatur von Wien; Aufgaben der Meteorologie.
		Hornstein.—Ueber die wahrscheinliche Abhängigkeit des Windes von den Perioden der Sonnenflecke.
		Kostlivy—Der täglicher und Jährlicher Gang der Temperatur zu Port Said und Suez.
		Normale fünftägige Wärmemittel in Réaumer-Graden für vier- und-zwanzig Stationen, bezogen auf den Zwanzigjährigen Zeitraum, 1848—1867.
		Lisnar.—Magnetische Declination und Inclination zu Wien, 1852—1871.
		Margules.—Ueber die stationäre Strömung der Elektricität in einer Platte, bei Verwendung geradliniger Elektroden.
		Mach, Tumlir und Kügler.—Ueber die Fortpflanzungsgeschwindigkeit der Funkenwellen.
		Puluj.—Ein Radiometer.
		Schell.—Das Stand-Aneroid Barometer.
		Sterneck.—Ueber besondere Eigenschäften einiger astronomischer Instrumente.
		Strasser.—Mittlere Temperatur von Kremsmünster.
		Wenzel.—Bahn des zweiten Kometen vom Jahre, 1874.
		Zeller.—Bahn des Planeten 162 "Laurentia."
		Weyprecht.—Astronomische und Geodätische Bestimmungen;
		Magnetische Beobachtungen;
		Die Nordlichtbeobachtungen.
Vizagapatam ...	A. V. Nursingrow, Esq. ...	Results of meteorological observations taken at G. V. Juggarow's Observatory, Vizagapatam, during 1878.
Washington ...	Chief Signal Office ...	International Bulletin, 6th February 1878 to 8th June 1879.
		Daily Bulletin of Weather Reports, Signal Service, United States of America, November and December 1874 and January to March 1875.
		Monthly Weather Review, November 1878 to December 1879.
		Report of the Chief Signal Officer, War Department, for 1878.
	Cleveland Abbe, Esq. ...	Physics of the Globe.
	Smithsonian Institution ...	Smithsonian Report for 1877.
	United States Naval Observatory.	A catalogue of 1,963 stars and of 290 double stars observed by the United States Naval Astronomical Expedition to the Southern Hemisphere during the years 1850—52.
		Zones of stars observed at the United States Naval Observatory with the mural circle in the years 1846 to 1849.

Presentations to the Library from the 1st April 1879 to the 31st March 1880—concluded.

Place.	Donor.	Title of Work.
Washington ...	United States Naval Observatory.	Report on the difference of longitude between Washington and St. Louis.
		On the right ascensions of the equatorial fundamental stars, and the corrections necessary to reduce the right ascensions of different catalogues to a mean homogeneous system.
		Zones of stars observed at the United States Naval Observatory with meridian transit instrument in the years 1846—1849.
		Zones of stars observed at the United States Naval Observatory with the meridian circle in the years 1847—1849.
		Tables for the reduction of transit observations.
		Report on the difference of longitude between Washington and Detroit, Michigan, Carlin, Nevada and Austin-Nevada.
Wellington ...	Meteorological Department ...	Abstract of meteorological observations, New Zealand, March to December 1878, and January to March 1879.
		Comparative table of climate as observed at the meteorological stations in New Zealand during 1877.
Zi-ka-wei ...	Observatoire de Zi-ka-wei ...	Bulletin Mensuel, December 1878, and title-page for Vol. IV.
		Bulletin des Observations, January to September 1879.
		La Lumiére zodiacale étudie é d'aprés les observations faites de 1875 and 1879.
		Le Typhon du 31 Juilet 1879.
Zurich ...	Swiss Meteorological Institute ...	Schweizerische Meteorologische Beobachtungen, 1876, and Supplement Band.

Purchases for the Library.

Abney's Manual of Photography.
American Journal of Science and Art, Vol. XVII, Nos. 97—102; Vol. XVIII, Nos. 103—108.
Annalen der Physik und Chemie, 1877, No. 1; 1879, Nos. 3—12.
Comptes Rendus de l'Académie des Sciences, Vol. LXXXVI, No. 5; Vol. LXXXVII, No. 17; Index to Vol. LXXXVII; Vol. LXXXVIII, Nos. 9—13 and 16—26; Vol. XXXIX, Nos. 1—13 and 15—26; and Index for Tome LXXXVIII.
Chauvenet's Spherical and Practical Astronomy, Vol. III.
Famines of the World.
Guyot's Meteorological and Physical Tables.
Hoffmeyer's Charts, December 1875, January to May 1876.
Memoirs of the Literary and Philosophical Society of Manchester, Vols. I to V (3rd series).
Modern Meteorology.
Nature, Nos. 403, 408, 434, 467, and 489 to 540.
Philosophical Magazine, Vol. VII, Nos. 42 to 45; Vol. VIII, Nos. 46 to 52.
Report of the British Association for the advancement of Science for 1879.
Saigey's Petite Physique du Globe, Parts I and II.
Handbuch der Barometrischen Höhenmessungen; with Atlas.
Nouvelles Etudes sur le Climat de Genéve.
Étude sur la circulation atmosphérique de l'Atlantique Nord.
Atlas Météorologique de l'Observatoire de Paris, Années 1875 and 1876.

SIMLA,
The 8th August 1880.

H. F. BLANFORD,
Meteorological Reporter to the Govt. of India.

APPENDIX A.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Bengal.

DURING the year under report, meteorological observations were taken regularly, according to the system established in the year 1875, at one first class observatory, seven second class observatories, and twelve third class observatories in Bengal and Assam.

The only first class observatory in Bengal is at Alipore. The Meteorological Reporter to the Government of India ruled during the past year that the observatory is directly under his control and superintendence, and not under the Meteorological Reporter to Bengal. It would therefore be out of place for me to report on the condition and working of the observatory.

Second Class Observatories.—These were seven in number, of which five are in Bengal and two in Assam. The following table gives the names of the superintendents and observers at these stations during the year:—

Stations.	Superintendents.	Observers.	Assistant Observers.
Sibsagar ...	Dr. M. Mukerjee [1] ... „ R. M. Meiklejohn, M.D.[2] ...	Baboo Dandadhur Dutta ...	Baboo Brikodar Dutta.
Goalpara ...	„ J. Slane ...	Maniruddin Ahmed ...	Kadimuddin.
Patna ...	„ R. Bird, M.D. [3] ... „ B. Simpson, M.D. [4] ... „ J. G. French, M.D. [5] ...	Munshi Mohabbat Lal. ...	*Name not reported.*
Hazaribagh	„ J. J. Wood, M.B [6] ... „ Edward A. Birch, M.D. [7] ... „ R. Cobb, M.D. [8] ...	Boz Rang Shohay [9] ... Sheik Rohimullah [10] ... Keder Nath Mukerjee [11] ...	Fouiz Khan.[12] Haripoda Banerjee.[13] Boz Rangshohoy.[14] Shaik Mohamed Ameer.[15]
Chittagong ...	....	Mr. J. M. Bennett [16] ... „ J. Dias [17] ... „ A. D. Sanges [18] ...	Mr. J. M. Convill.[19] „ M. K. D'Costa.[20] „ J. Dias.[21]
Saugor Island...	....	„ R. H. Peters.[24] ... „ W. C. Ghosh [25] ...	„ J. H. Encell.[22] „ A. D. Sanges.[23]
Cuttack ...	....	„ J. C. Smith ...	Mr. G. S. Adshead.[26] „ T. Breakey [27] „ H. W. Alley.[28]

[1] To 7th February 1880.
[2] Since 8th February 1880.
[3] To 20th April 1879.
[4] To 28th May 1879, and since 21st February 1880.
[5] From 30th May 1879 to 20th February 1880.
[6] To 2nd October 1879.
[7] From 3rd October 1879 to 25th January 1880.
[8] Since 26th January 1880.
[9] To 13th June 1879.
[10] From 16th June to 9th October 1879.
[11] Since 10th October 1879.
[12] To 30th April 1879, and from 22nd June to 31st July 1879.
[13] From 1st May to 15th June 1879.
[14] From 16th to 21st June 1879.
[15] Since 1st August 1879.
[16] From 1st to 7th April 1879, and 8th May 1879 to 31st January 1880.
[17] From 8th April to 7th May 1879.
[18] Since 1st February 1880.
[19] To 7th April 1879.
[20] From 8th April to 7th May 1879.
[21] From 8th May to 29th October 1879.
[22] From 30th October to 18th November 1879, and since 1st February 1880.
[23] From 19th November 1879 to 31st January 1880.
[24] To 14th February 1880, and since 18th March 1880.
[25] From 15th February to 17th March 1880.
[26] To 4th September 1879.
[27] From 5th to 15th September, and from 9th to 31st October 1879.
[28] From 16th September to 8th October 1879, and since 1st November 1879.

No change has been made in the general character of the observations and the working of these observatories during the year, beyond carrying out partially, the introduction of self-registering anemographs. The Meteorological Reporter to the Government of India proposed some time ago that all hese stations, excepting Sibsagar, should be furnished either with Beckley's or Casella's anemographs,

for automatic registration of wind direction and intensity.[1] Instruments were procured from England, and have been despatched to all the selected stations. At three of the stations, *viz.*, Saugor Island, Cuttack, and Chittagong, the instruments were placed in position during the year under report, and have furnished traces to the central office from the dates given below:—

Cuttack	...	...	...	...	...	10th April 1879.
Chittagong	...	...	...	...	...	20th June 1879.
Saugor Island	...	...	...	...	...	10th February 1880.

It was necessary to erect a small building for the reception of the anemograph at Hazaribagh. Sanction was obtained, and a building was erected at a cost of Rs. 460 on an open site specially selected. The building was completed, and registration of the wind commenced in the beginning of April 1880. Sanction was also obtained about the same time for the erection of a building on the roof of the cutcherry at Bankipore, for the reception of the instrument there. The Superintendent of the Patna Observatory informed me quite recently that the position and exposure of the observatory had been so materially altered for the worse by the erection of a building in its immediate neighbourhood, that he considers it advisable on this account, and for the convenience of the observer, that the observatory should be removed from its present site to a better site in the compound of the Temple School of Medicine. This contemplated change has unfortunately delayed the erection of the building for the anemograph, and nothing can now be done until the question of the removal of the observatory has been settled.

The second class observatories, more especially Cuttack and Saugor Island in Bengal, and Sibsagar in Assam, have maintained their character, during the year, for accurate and intelligent observation. I have only judged of the condition of these observatories from the returns sent into the office, as I was unable to visit any of the second class observatories. The only change which I proposed during the year, (and which has received the sanction of Government,) is the transfer of the Goalpara Observatory to Dhubri. Formerly the superintendent of the observatory, the Civil Surgeon of the district, lived in Goalpara, and was able to superintend it effectively. Recently, however, the head-quarters of the district were transferred from Goalpara to Dhubri; and for the last two or three years, the Superintendent of the Goalpara Observatory has lived at Dhubri, a distance of about sixty miles away, and has only visited the observatory periodically. As irregularities arose from this arrangement which it was impossible to avoid, I proposed the transfer of the observatory from its previous site to the present head-quarters of the civil authorities of the district, where it will be in a more favourable position, and will represent by its observations a larger area than it did at Goalpara; and where it will be more effectively superintended, and be much more easily accessible for inspection by the Meteorological Reporter than heretofore.

Third Class Observatories.—These are twelve in number, of which ten are in Bengal, one (Akyab) in Burmah, and one (Silchar) in Assam. Of the ten in Bengal, eight are maintained at the sole cost of Government, and one (Durbhunga) is maintained by the Maharaja of Durbhunga. The remaining one (Demagiri), in the Chittagong Hill Tracts, was established by the Deputy Commissioner, under the rules laid down and sanctioned by the Government of India for the regulation of volunteer observatories and observers. The names of the superintendents and observers at these twelve observatories, during the year under report, are given below:—

Stations.	Superintendents.	Observers.
Darjeeling ...	... ...	Mr. J. Blong.[1]
Purneah ...	Dr. Picachy	„ E. S. Aratoon.[2] Baboo Kumode Behary Samanto.[3] „ Gunga Narain Rai.[4]

[1] To 6th December 1879, and since 13th December 1879.
[2] From 7th to 12th December.
[3] To 24th June 1879, and 21st September to 17th October 1879.
[4] From 25th June to 20th September 1879, and since 18th October 1879.

Stations.	Superintendents.	Observers.
Durbhunga	Dr. E. Bovill[1] Baboo Kally Dass Basu[2] „ Ramchunder Sen[3] Dr. R. G. Mathew[4]	Baboo Jogin Chunder Banerjee.
Gya	„ J. W. Mullen[5]	Nowrungee Lall.
Berhampore	„ R. Macleod[6]	Baboo Mahendra Nath Ray.
Burdwan	„ S. M. Shircore „ W. F. Murray[7] „ Dinobundho Dutt[8] „ K. P. Gupta[9]	„ Mokhoda Prosad Chowdhry.
Jessore	„ Gordon Price	„ Pareshnath Roy Chowdhry.[10] „ Rajani Kant Sen.[11]
Dacca	.....	Mr. E. W. Shave.
Silchar	„ R. N. Campbell[12]	Baboo Romes Chunder Bhadra.
Demagiri	„ J. J. Monteith[13]	„ Debendra Nath Guho.
False Point	.....	Mr. H. W. Alley.[14] „ G. S. Adshead.[15] „ J. P. Allan.[16]
Akyab	.....	„ E. B. Atkinson.[17] „ E. Pereira.[18] „ J. M. Bennett,[19]

[1] To 20th August 1879, and from 3rd December 1879 to 12th January 1880.
[2] From 21st August to 2nd December 1879, 13th to 15th January, and 3rd to 11th March 1880.
[3] From 16th January to 2nd March 1880.
[4] Since 12th March 1880.
[5] To 21st April 1879.
[6] Since 22nd April 1879.
[7] To 11th July 1879, from 14th to 21st October 1879, and since 23rd November 1879.
[8] From 12th to 13th July, and 22nd October to 22nd November 1879.
[9] From 14th July to 13th October 1879.
[10] To 5th October 1879, and since 31st October 1879.
[11] From 6th to 30th October 1879.
[12] To 28th May 1879.
[13] Since 29th May 1879.
[14] To 5th August 1879.
[15] From 6th August 1879 to 18th February 1880.
[16] Since 19th February 1880.
[17] To 19th May 1879.
[18] From 20th May 1879 to 6th February 1880.
[19] Since 7th February 1880.

All these stations are, I believe, in satisfactory working order; and the observations furnished by them are, with very rare exceptions, now accurate and reliable. The recent improvement in the observations at these stations is undoubtedly due to the rapid transmission of the daily 10 A.M. observations by post or by telegraph. This enables the work of the observers to be continuously compared and criticised day by day, and secures immediate attention to, and rectification of errors and faults of observation.

I visited several of these observatories during the year, *viz.*, Darjeeling, Purneah, Gya, Durbhunga, and Burdwan. The Darjeeling Observatory is situated in the middle of the station, in the compound of the Telegraph Office, on a very circumscribed and unsuitably exposed site. The Telegraph Master is an unusually careful observer, but the thermometric and wind observations of this station are very much affected by the position of the observatory—surrounded by houses, and situated at some distance below the top of the hill on which it is erected. The only proper and suitable position for an observatory at a Himalayan hill station appears to me to be the summit of an open hill. A change of site of an observatory is, however, extremely undesirable, more especially at a hill station, where differences of level and exposure render intercomparison between the two sets of observations difficult, if not impossible. If I can in any way arrange for the erection of a wind vane and anemometer, or of a self-registering anemograph, at one of the many suitable high open sites in Darjeeling, and carry on the observatory in its present site, Darjeeling will become one of our most useful and valuable hill stations.

Purneah during the year had a change of observers. The persistence of an unusually well-marked barometric depression at this station during the rains (which followed this change of

observer), although accompanied by extremely heavy rainfall, seemed to me to require verification. I examined the observatory, its instruments, and observer very thoroughly and carefully. The observer is well acquainted with his work, and apparently very anxious to do good work, and I have every reason to believe that the Purneah observations of the present observer may be relied upon.

Gya and Durbhunga I found to be in satisfactory working condition. The observations from both these places have improved recently, and are now upon a par for accuracy with those of other third class stations.

The Burdwan Observatory I also found to be in thoroughly effective working order. The observer is intelligent, and does his work accurately and well. The third class stations which I did not visit during the year are, so far as I can judge from their returns, in efficient working order.

In addition to these, there are 162 stations which record only rainfall, and send in their returns weekly to the central office for publication in the Gazette.

Central Office.—Several changes and additions have been made to the work of the office. The present personnel of the office is given in the following table :—

Office Establishment of the Meteorological Reporter to the Government of Bengal.

NAMES.		RANK.
Baboo Fanindra Mohun Basu[1]	...	... Head Clerk in charge.
„ Poorno Chunder Mookerjee	...	... 2nd Clerk.
„ Kamini Mohun Basu	...	... 3rd do.
„ Jogeshur Roy	...	... Tabulator.
„ Debendro Nath Banerjee	...	... Ditto.
„ Banikant Roy Chowdhry	...	... Ditto.

The most important part of the current work of the office consists in the reduction of the observations furnished to this office, and their tabulation in a permanent form for the use of the Government of Bengal and of the Meteorological Reporter to the Government of India. At the beginning of the year, the office published the following returns in the *Calcutta Gazette* :—

1st.—A monthly summary of the observations taken at the observing stations in Bengal and Assam.

2nd.—A weekly summary of the telegraphic weather observations received daily from certain stations on the coast of the Bay.

3rd.—A weekly report of the rainfall at the 162 revenue stations which furnish weekly postal reports of rainfall to this office.

In addition to these, a statement of daily rainfall was published monthly for the use of certain officers, including certain Irrigation Officers and the Board of Revenue. I proposed to the Government of Bengal, at the end of the year 1879, that the second of these statements should be discontinued as unnecessary; and that the third should be published in an extended form monthly, giving the daily rainfall of each station, instead of the amounts for periods of a week. As the publication of the latter return would render unnecessary the separate return published for the Board of Revenue, I also proposed that that return should be discontinued. The Government of Bengal sanctioned the changes. They came into operation at the beginning of the year 1880. These changes have slightly diminished the work of the office, and it is believed furnish much more complete and satisfactory returns of meteorological data and rainfall than the old forms of publication.

Daily Weather Reports.—During the present year I submitted proposals for the extension of the telegraphic weather-reporting system, established some years ago for the protection of the port of Calcutta. The proposals were as follow :—

1st.—The extension of the number of reporting stations from seven to fifteen.

2nd.—The daily publication of the observations in a manner intelligible to the ordinary public, and of a chart illustrative of the meteorology of the Bay of Bengal for each day.

[1] Is the Head Clerk of the Office of the Meteorological Reporter to the Government of India.

3*rd*.—The acceleration of the telegrams by the Telegraph Department, so that the weather report and chart, based on the 10 A.M. observations, might be published and distributed to subscribers not later than 4 or 5 P.M. of each day.

The Government of Bengal having ascertained that a sufficient number of subscribers (at Rs. 2 per mensem) could be obtained, to cover the expense of printing and distributing the daily reports, sanctioned the scheme. As I considered the extension of very great importance, I arranged to commence the publication from the 1st of April 1880 by means of chromographs, pending the arrival of the proper lithographic presses indented for from England for use in the India Meteorological Office. The publication has, I am assured, supplied a pressing want for the port and town of Calcutta, and it will, I trust, become one of the most prominent and useful features of the work of the Bengal Meteorological Department.

Ocean Meteorology.—The study of cyclones and the extension of the present Indian telegraphic weather-reporting systems have shewn the advisability of a more complete knowledge of the meteorology of the Indian Ocean, and its arms—the Bay of Bengal and the Arabian Sea. During the past year, at the instance of the Government of India, the Meteorological Reporter to the Government of India took up the consideration of the question. He asked my opinion as to what should be done to supply this gap in our meteorological work and system. The result of the correspondence on the subject is, that the Government of India has sanctioned the establishment of a small office under my superintendence to deal with this subject. Additional stations have been established or brought into connection with the Indian system, including Aden and Amini Divi in the Laccadives. One of the earliest labours of this new branch of the Bengal Office will be to go through the observations of the Indian seas collected by the Board of Trade. These will be duly studied and digested, and published in a form similar to that adopted by the Meteorological Office in England, in the discussion of the Atlantic observations already published, mainly for the information of captains of ships. Another feature of the work will be to endeavour to collect accurate observations of the meteorology of the Bay of Bengal and Arabian Sea, by means similar to those employed by the Board of Trade. This work will date from April 1880.

Storm Signals.—These were not hoisted at all during the year. The commencement and termination of the monsoons were marked by several small cyclonic storms, one of which visited the Madras coast in May, two or three the Orissa coast, and one the coast of Arracan near Cox's Bazar. They were all of small diameter, and did not affect the weather at the mouth of the Hooghly or in the river so far as to necessitate the hoisting of the storm signals.

JOHN ELIOT,
Meteorological Reporter to the Govt. of Bengal.

APPENDIX B.

Extract from the Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh, for the year 1879-80.

DURING the year under report, meteorological observations were taken regularly, according to the system inaugurated in 1875. Twelve Government observatories, under the Meteorological Department, have continued to send returns to my office, and copies of the registers kept at the Survey Office at Dehra Dun have been received regularly every month. The Meerut Observatory, supported by the municipality of that town, has also continued to furnish returns, similar in every respect to those obtained from Government observatories of the third class.

Classification of Observatories.—In the first table appended to this report, the fourteen observatories are classified, and the names of the superintendents and observers who have acted during the year are given. At all the observatories, complete sets of observations are taken at 10 A.M. and 4 P.M.; but at those of the second class, an additional set is taken at 7-35 A.M., Washington time (about 6 P.M. at most of the stations), and these are sent to the United States Signal Service Office at Washington, where they are published as part of an "international daily bulletin." At the second class stations, hourly observations continue to be taken on four days in each month. These

now extend over nearly five years, and will probably soon yield sufficient data for determining the diurnal inequalities of the several elements of observation, with a considerable degree of exactness.

Allahabad Observatory.—The application, mentioned in last year's report, for the use of an unoccupied wing of the public library building in the Alfred Park, for the accommodation of the meteorological office and observatory, was at first favourably considered by the local Government. Plans and estimates for the erection of a thermometer shed, and for making some slight but necessary alterations in the interior of the building, were then sent up through the Executive Engineer, and I fully expected to see the office and observatory established in the new quarters before the end of the year 1879. For several months after these plans were submitted to Government, I heard nothing more of the matter officially; but I have just now received a letter, in which I am informed that the building that was to be used for the meteorological office will be required for an archæological museum, and that provision will probably be made for the meteorological establishment at the new Muir College. This building will not be finished for several years yet, and meantime the observatory remains attached to the Meteorological Reporter's house, and continues to work as one of the second class, with the exception that two additional observations are taken daily at 4 A.M. and 10 P.M. For the present there is little practical disadvantage in retaining the observatory on the site it has occupied for nearly six years, but some permanent arrangement will be imperatively required whenever the self-registering instruments arrive. It is now nearly three years since these instruments were due, and they must arrive soon. The worst of the present situation of the observatory is that the wind observations are nearly worthless, because the place is so surrounded by trees.

Other Observatory Buildings.—The thermometer sheds and other buildings of the several observatories have been maintained in good condition during the year. The Ajmere Observatory, on which I had to report unfavourably last year, was re-constructed on a new site near the kutcherries, where the exposure is much better than at the jail; and the instruments were moved into the new building at the beginning of the year. Dr. Newman, the present superintendent, who takes an intelligent interest in meteorology, got this work accomplished, and has also determined the elevation of the new position of the barometer above sea-level.

A large railing was put up round the observatory shed at Bareilly, last January, to protect the instruments from theft, and a similar enclosure at Chakrata was renewed during the year. Some building work had also to be done at Roorkee, to prepare a place for the anemograph erected there. The old instrument shed at Allahabad has now been re-roofed, and will probably stand for two or three years longer if required.

Supply of Instruments.—Complete sets of instruments have been maintained as far as possible at all the observatories. The most important break in the observations, owing to want of the necessary instruments, is one of nearly three months in the barometric registers of Jhansi. The barometer in use became unserviceable at the beginning of May, and it was not until near the end of July that another could be obtained to replace it. There was no want of thermometers at any station, except of those for nocturnal radiation, which are frequently broken, and very often go out of order. The anemograph at Lucknow has worked regularly throughout the year, but, judging from the very low velocities it records, it does not work so freely as it ought to do. Another Beckley's anemograph has been erected at Roorkee, and has sent in traces since August last. Dr. Murray Thomson took a great deal of trouble in setting up this instrument, and it has run very well ever since the commencement. The Casella anemograph that was sent to Agra last year could not be put up there, as there was no suitable place for it. After lying for some time at Agra, it was sent to Sutna, a good station for wind observations, where it will probably soon be erected.

The only novel instrument brought into use during the year is a barograph by Hicks, which was set up at Allahabad at the end of February. It marks the height of the barometer on a sheet of ruled paper every hour. The traces of the instrument may be of some use in determining the diurnal variation of pressure, if taken in combination with frequent readings of a standard barometer, but otherwise the difficulty of making the requisite corrections for variations of temperature would detract a good deal from its value.

Instrumental Corrections.—The Calcutta corrections supplied with the barometers in use at the several stations have been applied to all the readings. At the stations I visited during the year, the barometers were compared with a travelling barometer supplied from the Calcutta office, and the corrections deduced from these comparisons differed so little, in most cases, from those determined by longer series of comparative observations in Calcutta, that the latter were retained.

The following instruments were compared with a travelling mountain barometer (No. $\frac{5}{1878}$) by Adie :—

Observatory.	Barometer number.	Maker.	Old correction.	New correction.	Difference.
			″	″	″
Agra	968	Casella	+ ·007	+ ·010	·003
Meerut	631	Ditto	+ ·003	+ ·003	·000
Roorkee	$\frac{1}{1869}$	Adie	— ·036	— ·037	·001
Dehra	84	Newman	+ ·903	+ ·005	·002
Chakrata	$\frac{9}{1875}$	Adie	+ ·007	+ ·023	·016
Sutna	$\frac{8}{1875}$	Ditto	+ ·015	+ ·027	·012

The differences in the last column are all inconsiderable, except in the case of Chakrata and Sutna. The barometers in use at these two stations, were of the same class as the travelling barometer with which they were compared, and they appeared to be in equally good, if not better, condition. The corrections of all three instruments had been previously determined in Calcutta in the same way, but at a higher pressure than that observed at the stations. There was, therefore, no good reason for considering the travelling barometer to be correct and the others wrong, and consequently the old corrections were retained. The only way of determining which instrument was most probably correct would be to have several travelling standards.

The barometers at Benares and Lucknow, both Casella standards, were afterwards compared with an instrument of the same kind that I carried with me when inspecting those stations. The difference between the previously-assigned correction of the Benares barometer and that deduced from a short series of comparative readings with the travelling instrument was only ·002″, and the corresponding difference for the Lucknow instrument was ·009″. The latter difference is no greater than has often been found by Mr. Eliot and myself, to obtain among the readings of new barometers, to which the corrections determined in Calcutta have been applied. Such discrepancies are probably due in part to differences in the graduation of the scales, which have not the same error throughout their length, and partly also to unequal rates of expansion by heat.

The thermometers in use at Allahabad, Benares, and Lucknow have had their errors re-determined by comparison with a Kew standard, No. 30382, sent up from Calcutta by Mr. Blanford. In every case the freezing point of the mercurial thermometers was found to have risen a small fraction of a degree since the instruments came into use, while the indications of the spirit thermometers were little changed. In future tours of inspection I intend to carry this instrument with me to test the thermometers, and I shall endeavour to have at least two travelling barometers.

Inspection of Observatories.—The observatories at Agra, Meerut, Roorkee, Dehra, Chakrata, and Sutna were visited during the months of May and June, and everything connected with them was found generally satisfactory. On the way to Chakrata I took the opportunity of visiting two private observatories at Mussooree, one at the Survey Office on the top of the hill, about 7,000 feet above sea-level, and the other at St. Fidelis's School, nearly 2,000 feet lower. The registers of the latter are transmitted regularly to the Calcutta office, and the former, which is only in operation during the

summer months, contributes daily telegrams during the rainy season. The observations taken at both places seem to be of great value, but the barometer at the lower observatory had met with an accident a few days before my visit, and was reading nearly a tenth of an inch too low. It was shortly afterwards replaced, I believe, by a new instrument from Calcutta. A most important part of the observations taken at the Survey Office, is the trace of an anemograph placed on the roof of a house built on the highest part of the ridge, called the "Camel's Back."

Benares and Lucknow were visited near the end of October, and everything was found in good order. I intended to visit Jhansi at the end of the year, but was prevented at last from doing so.

Character of Observations.—The observations taken during the year, were all apparently of a high character as regards accuracy. At one or two of the outlying stations, such as Jhansi and Ajmere, the observations of single days sometimes do not accord well with those taken at the other stations; but the monthly means agree very well, and it is probable that all the observations have been fairly and honestly taken. Dr. Murray Thomson has succeeded in showing, I think, that my condemnation of some of the hourly observations at Roorkee in last year's report was too hasty, and that in some cases, at least, very surprising coincidences among the observations of consecutive hours do really occur. He deserves every commendation for the way in which he has taken up and enquired into this matter.

The weekly and monthly returns for all the stations have been received in good time during the year; and the daily weather telegrams sent to Calcutta from Agra, Ajmere, Allahabad, Benares, Lucknow, Bareilly, and Roorkee, appear to have been despatched regularly in most cases. At some stations, however, the Sunday telegrams have nearly always been delayed a day, but this has been owing to the arrangements of the telegraph offices, and not to any fault on the part of the observers.

Office and Office Work.—The proposed addition of another clerk to the staff of my office, mentioned in last year's report, was not sanctioned by the Government of India. An extra man was, however, temporarily engaged from 1st August to the end of March last, and without his assistance it would have been impossible to carry on the work of the office. The current work even now is considerably in arrears, and the office staff can render me little or no assistance in any special work I may wish to undertake. If the object of meteorological observations be the mere collection of tables of statistics, the present establishment is just barely sufficient for the purpose; but if any useful knowledge is to be deduced from the statistics when collected, further clerical assistance should be provided.

The Head Clerk, Baboo Chintamoney Ghosh, has done as much with the aid of the present small staff as could be done, and he has deprived himself of many holidays to which he was entitled in order to carry on the work. Seeing that he has had no increase of pay since his first appointment, six years ago, I think he deserves something in the way of promotion. Proposals regarding the desired increase in the office establishment are again being sent up through the regular channel.

The current work of the office has consisted in applying the primary corrections and reductions to the observations and preparing the permanent registers; in compiling for publication abstracts of the monthly registers and of the weekly rain returns received from the sub-divisional stations of the North-Western Provinces and Oudh; and in preparing copies of the observatory registers to send to the head office. All this work, except the copying of the registers, has been kept fairly up to date, but the last copies of registers for 1879 have only just been finished.

Besides the weekly rainfall statements and the monthly meteorological abstracts published in the local Gazette, an annual rainfall statement for the year 1879 has been prepared and published, and the observations taken at Allahabad have been printed daily in the *Pioneer*. Since the 1st January, the normal temperature and rainfall for each day at Allahabad, derived from ten years' observations, have been published for comparison with the actual observations of each day.

The report on the rainfall of the North-Western Provinces and Oudh, mentioned last year, has been printed and distributed. At the time, when it was thought that the Allahabad Observatory was about to be removed to the Alfred Park, I commenced to work up the more important results of observations hitherto taken, and a paper dealing with these is nearly ready for publication in the "Meteorological Memoirs."

Library.—The library received more additions in the way of annual reports, &c., last year than in previous years. A number of duplicate copies of various scientific publications has also been sent by Mr. Blanford from the Calcutta office.

ALLAHABAD,
The 8th April 1880.

S. A. HILL, B. Sc.,
Meteorological Reporter to Govt., N.-W. Provinces and Oudh.

Names of the Observers and Superintendents of the several Observatories in the North-Western Provinces and Oudh during the year 1879-80.

	Observatory.	Observer.	Superintendent.
Second Class.	Allahabad	Kedar Nath Chatarji, with an assistant	S. A. Hill, Esq.
	Agra	Mir Altaf Ali, with an assistant ...	Dr. A. H. Hilson.
	Lucknow	Chotay Lal, with an assistant	Dr. J. C. Whishaw. Dr. B. Franklin.
	Roorkee	Chiranji Lal, with an assistant ...	Dr. Murray Thomson.
Third Class.	Chakrata	Salig Ram	Colonel Dawson, R.E. Captain Tomkins, R.E.
	Ranikhet	Jewanand	No Superintendent.
	Dehra	The head computers	J. B. N. Hennessey, Esq.
	Meerut	Har Saran Das	Dr. W. Moir.
	Bareilly	Jwala Prasad	E. A. Phillips, Esq.
	Gorakhpur	Sheo Lochan	Dr. C. Prentis.
	Benares	Devakinandan Patak ...	J. C. Nesfield, Esq. G. Thibaut, Esq., Ph.D.
	Jhansi	Kalka Das	Dr. R. Tate. Dr. Shircore.
	Ajmere	Ram Prasad	Dr. Newman.
	Sutna	Har Nath	Dr. S. J. Goldsmith.

APPENDIX C. I.

Administration Report of the Meteorological Reporter to the Government of the Punjab.

I HAVE the honour to report that the following officers were in charge of the Meteorological Reportership, Punjab, during the year 1879-80: Surgeon-Major A. Neil was in charge from the 1st April till his death, on the 22nd July 1879; from that date till the 18th August, the office was held by Surgeon-Major T. E. B. Brown; from 19th August till the 17th October, Mr. Oman, Professor, Government College, was in charge; and from 17th October 1879 till the end of the year Surgeon E. Lawrie.

2. The following work was done in my office:—

(*a.*) The management of the Lahore Observatory has been conducted by Jasput Rai and his assistant, Divan Chand, very satisfactorily throughout the year.

(*b.*) All observations received, from the several observatories have been forwarded after revision.

3. No change has been made during the year in the observatories and in the method of observations, reductions, &c. No observatory has been suppressed or new one established.

4. I took charge of the office on 17th October 1879, in the middle of the session of the Medical School, and consequently had no time to inspect more than two observatories. I intend, however, to inspect them all once at least in the course of the present year.

5. The two observatories inspected during the year by me were Ludhiana and Delhi. At Ludhiana, great irregularity in the observations had been noticed during the months of August and September. It was satisfactory to find, on inspection, that these irregularities had taken place during the absence, on deputation, of the regular observer, Assistant-Surgeon Gokul Chand, who was in no way responsible for them.

6. At Delhi I discovered that the Assistant-Surgeon in charge of the observatory had been in the habit of deputing his duties to compounders and servants of the hospital, and, as I had reason to suspect that this practice was common among observers generally, I issued a circular directing that in future all observations submitted to this office should be accompanied by a declaration that the observer himself had taken them. If, from any cause, observers were prevented from taking the regular observations, they were to be omitted, and never recorded when taken by subordinates.

7. A table showing the names of the observers and superintendents of the observatories in the Punjab will shortly follow.

LAHORE,
The 5th April 1880.

E. LAWRIE, M.B.,
Meteorological Reporter to the Govt. of the Punjab.

APPENDIX C. II.

List showing the Names of the Superintendents and Observers in charge of the Observatories in the Punjab in 1879-80.

Nos.	Observatories.	Classes.	Names of Superintendents.	Period. From	Period. To	Names of Observers.	Period. From	Period. To	Remarks.
1	Lahore ...	2nd Class Observatory.	Dr. A. Neil ...	1st April 1879	22nd July 1879	Baboo Jasput Rai.	1st April 1879	31st Mar. 1880	
			„ T. E. B. Brown ...	23rd July „	18th Aug. „	„ Divan Chand, Assistant.			
			Mr. C. Oman ...	19th Aug. „	16th Oct. „				
			Dr. Edward Lawrie ...	17th Oct. „	31st Mar. 1880				
2	Sialkot ...		Assistant-Surgeon Fatteh Sing.	1st April „	22nd May 1879	Assistant-Surgeon Fatteh Sing.	1st „ „	31st „ „	
			Dr. A. K. Reed ...	23rd May „	10th Jan. 1880				
			Assistant-Surgeon Fatteh Sing.	11th Jan. „	15th Feb. „				
			Dr. M. Gaisford ...	16th Feb. „	31st Mar. „				
8	Peshawar ...		„ A. Taylor ...	1st April „	30th Sept. 1879	Kashi Ram, Head Assistant.	1st „ „	31st „ „	
			„ B. Doyle ...	1st Oct. „	22nd Oct. „				
			„ G. C. Ross ...	23rd „ „	31st Mar. 1880				
4	Rawalpindi ...		„ Henderson ...	1st April „	31st „ „	Assistant-Surgeon Bhowani Dass.	1st „ „	31st „ „	
5	Murree ...		Rev. G. C. Peak ...	1st „ „	31st „ „	Mr. R. Johnson ...	1st „ „	31st „ „	
6	Delhi ...	3rd Class Observatories.	Dr. J. Fairweather ...	1st „ „	30th April 1879	Radha Kishen ...	1st „ „	14th May 1879	Inspected on the 21st December 1879.
			„ J. Ferguson ...	1st May „	18th Sept. „	Ram Kishen ...	15th May „	3rd July „	
			„ J. Fairweather ...	11th Sept. „	31st Mar. 1880	Bagwan Dass ...	4th July „	25th Dec. „	
			„ J. C. Penny ...	1st April „	5th April 1879	Radha Kishen ...	26th Dec. „	31st Mar. 1880	
7	Multan ...		„ R. Gray ...	6th „ „	31st Mar. 1880	Vahid Ally Shah ...	1st April „	31st „ „	
8	Dera Ismail Khan		„ A. McGregor ...	1st „ „	7th April 1879	Noor Buksh, Hospital Assistant.	1st „ „	4th June 1879	
			„ R. J. Taaffe ...	8th „ „	22nd „ „				
			„ A. McGregor ...	23rd „ „	24th June „	Chiman Lall, Clerk ...	5th June „	4th July „	
			„ P. deH. Haig ...	25th June „	21st Aug. „	Noor Buksh, Hospital Assistant.	5th July „	31st Mar. 1880	
			„ A. McGregor ...	22nd Aug. „	11th Sept. „				
			„ J. Blood ...	12th Sept. „	31st Oct. „				
			„ P. deH. Haig ...	1st Nov. „	19th Dec. „				
			„ R. J. Taaffe ...	20th Dec. „	31st Mar. 1880				
9	Sirsa ...		„ J. Rehill ...	1st April „	31st „ „	Fazalor Rahman, Head Assistant.	1st April „	31st „ „	
10	Simla ...		Captain M. J. K. Harman	1st „ „	31st „ „	L. J. Pepperell ...	1st „ „	31st „ „	
11	Leh—Ladakh ...	2nd Class ...	Joint British Commissioners.	1st „ „	31st „ „	H. A. Charagdin ...	1st „ „	31st „ „	
						Bhola Nath, Assistant	1st „ „	31st „ „	
12	Ludhiana ...	3rd Class ...	Surgeon-Major R. Rouse	1st „ „	31st „ „	Devi Chand ...	1st „ „	31st May 1879	Inspected on the 14th December 1879.
						Bhagat Ram ...	1st June „	25th Oct. „	
						Gokul Chand ...	26th Oct. „	27th Mar. 1880	
						Bhagwan Dass ...	28th Mar. 1880	31st „ „	

LAHORE,
The 13th April 1880.

E. LAWRIE, M.B.,
Meteorological Reporter to the Govt. of the Punjab.

APPENDIX D.

Return showing the Names of the Superintendents and Observers at the several Observatories of the Central Provinces during the year 1879-80.

Observatories.	Superintendents.	From	To	Observers.	From	To	Remarks.
Nagpur	Dr. Leckler	1st April 1879 ...	31st Oct. 1879 ...	T. V. Vartharapoloo	1st April 1879 ...	2nd May 1879.	
	,, Evers	1st Nov. ,, ...	15th Nov. ,, ...	T. V. Allagherswamy	3rd May ,, ...	23rd Mar. 1880.	
	,, Leckler	16th ,, ,, ...	31st Mar. 1880 ...	Krishnaji Anant	24th Mar. ,, ...	31st ,, ,,	
				T. V. Allagherswamy (Assistant) ...	1st April ,, ...	2nd May 1879.	
				P. Soobiah (Assistant)... ...	3rd May ,, ...	31st Mar. 1880.	
Jubbulpore ...	Surgeon-Major J. Brown, M.D. ...	1st April ,, ...	2nd July 1879 ...	Baboo Prosuno Coomar Bose ...	1st April ,, ...	21st June 1879.	
	Surgeon-Major W. R. Rice, M.D. ...	3rd July ,, ...	31st Mar. 1880 ...	Zynoolabdeen (Assistant) ...	1st ,, ,, ..	31st Mar. 1880.	
				Kuonj Behary Lall (Assistant) ...	22nd June ,, ...		
Pachmarhi ...	Lewis Gordon, Esq.	Throughout the year ...		Madho Rao	Throughout the year.		
				Narain Bhagwant (Assistant) ...			
Saugor	Surgeon-Major D. F. Bateman ...	1st April 1879 ...	18th Sep. 1879 ...	Deendyal Pathuck	1st April 1879 ...	31st Mar. 1880.	
	,, John William Strong ...	19th Sep. ,, ...	31st Mar. 1880 ...	Kalika Pershad	1st ,, ,, ...	12th July 1879.	
Hoshangabad ...	Assistant Surgeon Kunja Lal Sanyal ...	1st April ,, ...	17th Aug. 1879 ...	Ramgolam Tewary	13th July ,, ...	27th Aug. ,,	
	Surgeon S. H. Browne, M.D. ...	18th Aug. ,, ...	31st Mar. 1880 ...	Jodunath Bose	28th Aug. ,, ...	31st Mar. 1880.	
Nimar	Surgeon-Major P. Cullen, M.D. ...	1st April ,, ...	6th May 1879 ...	Rajaram Nana Bhai	1st April ,, ...	22nd ,, ,,	
	,, T. Mayne	7th May ,, ...	15th July ,, ...	Beharilal Ram Lal	23rd Mar. 1880 ...	31st ,, ,,	
	Dr. J. L. Corbett, M.D.	16th July ,, ...	10th Nov. ,, ...				
	Surgeon-Major P. Cullen, M.D. ...	11th Nov. ,, ...	31st Mar. 1880 ...				
Seoni	Surgeon W. E. Johnson, M.D. ...	1st April ,, ...	4th Dec. 1879 ...	Punchum	Throughout the year.		
	Assistant-Surgeon Kali Krishna Ghose	5th Dec. ,, ...	11th Jan. 1880 ...				
	Surgeon-Major J. B. Gaffney ...	12th Jan. 1880 ...	31st Mar. ,, ...				
Chanda	Honorary Surgeon M. Craggs ...	Throughout the year.		Seetaram			
Sironcha	Asst.-Surgn. Harran Chunder Dutt ...	1st April 1879 ...	31st Mar. 1880 ...	P. Moothoo Krishna Naido ...	1st April 1879 ...	28th Feb. 1880.	
				Asst.-Surgn. Harran Chunder Dutt	29th Feb. 1880 ...	31st Mar. ,,	
Raipur	Surgeon-Major J. B. Gaffney ...	1st ,, ,, ...	23rd Dec. 1879 ...	Krishna Rao	Throughout the year.		
	,, D. W. Trimnell ...	24th Dec. ,, ...	31st Mar. 1880 ...				
Sambalpur ...	Honorary Surgeon J. E. Harrison ...	Throughout the year.		Baboo Shamsoonder Dass ...			

NAGPUR,
The 7th July 1880.

APPENDIX E.

Extract from a Report sent to the Sanitary Commissioner, Central Provinces, on the condition of the Observatories inspected by the Meteorological Reporter to the Government of India.

JUBBULPORE.—This has been for many years past an exceedingly well-conducted observatory, and, except as regards the position of the wind vane and anemometer, which are too near the ground to show well the movement of the wind, the arrangements leave little to be desired. The instruments were all in excellent condition, and the observer appears to be well acquainted with his work.

The thermometers are exposed in a louvred shed, of a pattern different from that adopted at most other Indian observatories, but the exposed position renders it necessary to afford them more protection than at stations where the shed is in an enclosure; and I find, on comparing the temperature within the shed with that shewn by a sling thermometer outside, that the former is not greatly different from the true temperature of the atmosphere. * * * *

HOSHANGABAD.—This observatory had been visited by myself in 1875, and by Mr. Eliot in 1878. The present site is very much better than that occupied at the time of my first visit, and the only drawback is that it is somewhat encumbered by trees. The instruments were generally in good condition, but I found the barometer improperly suspended. Instead of being suspended by the pivots resting on the ring of the tripod stand, it was hung on a cord from the roof, and confined below within the stand, and not quite vertical. I suspended it in the proper manner, and cleaned the cistern, which had become somewhat dirty by the oxidation of the mercury.

The anemometer also was cleaned and refixed.

The rain-gauge stands on a slab of sandstone, and the mouth is therefore more than one foot above the ground level, which is the proper height, as directed in rule 49, Instructions, p. 88. This should be altered. The wind vane is fixed on the top of one of the posts of the thermometer shed, surrounded, as the shed is, by trees, which greatly dominate the vane. This position is not a good one, and it would be better to fix it on a post rising 3 or 4 feet above the roof of the room in which the barometer is placed, but as far as possible from the anemometer.

PACHMARHI.—This observatory has not been visited previously either by Mr. Eliot or myself. The situation is probably as good as any to be found in the station, being comparatively high and open. The hills on the west and north must interfere with winds blowing from any direction between west and north-east; but there is probably no part of the station free from similar obstacles.

The barometer is set up in the thermometer shed—a most objectionable position, and one which is emphatically condemned in the Instructions, both in paragraph 17, page 15, and also in rule 9, page 84, which states that "a thermometer shed is the worst possible place for (the barometer)." I have requested that it may be removed to a room in the cutcherry close by. The difference of the elevation in its present and proposed situations should be ascertained by spirit-levelling and reported. I understand that the barometer which was in use for a few months of last year was (properly) set up in the office room; but the change of elevation involved when this instrument was brought into use, and again when the observations were resumed with the instrument in the shed, was not reported, and thus an error of unknown amount was introduced into the registers. In paragraph 16, page 14 of the Instructions, it is directed—"If a barometer is moved to another place, the difference of level must be determined; and until this has been done, and the resulting correction applied, the readings taken before and after the removal are not comparable with each other;" and in the sheet of "Memoranda for the guidance of Officers inspecting Observatories," copies of which have been issued to all observatories, with the direction that it should be suspended in the office room of every observatory, the third memorandum relating to the barometer is, "Is it in the proper place, the level of which has been determined?" These specific directions have evidently been overlooked. I have

cleaned and re-verified the barometer, but in its present position it is impossible to take accurate readings.

The thermometers were in good condition, excepting the minimum wet bulb, which had a drop of spirit, representing about 6·3° of the scale, lodged in the upper end of the tube, and which had escaped detection. It is to be feared that the readings of this instrument for some time past will have to be rejected.

The wind vane and anemometer are too low, only 6 or 7 feet above the ground, and a large tree on the east, situated within 50 yards, is a serious obstacle. It would be better to set up a special framework of posts, which shall elevate them about 25 feet above the ground, on the high ground, but as far as possible from trees. At present their indications cannot be of much value.* * * *

SAUGOR.—This station also has not been inspected previously either by Mr. Eliot or myself. It furnishes another striking instance of the neglect of emphatic standing rules, in the fact that, almost a year ago, the barometer was removed from its former position at the police lines to the Civil Surgeon's office opposite the jail, and that no report of change of the position was ever made to my office. As the present site is rather more than 60 feet lower than that which the instrument formerly occupied, the subsequent readings of the instrument, reduced to sea-level, were found to be so high, and discordant with reference to those of other stations, that they have been rejected as untrustworthy. Doubtless the removal was made with the best intentions, but it is much to be regretted that in this, as in some other cases, the superintendents of observatories, before making supposed improvements, do not take the trouble to refer to the book specially prepared for their guidance. A further objection to the present position of the barometer is, that it is at a good 10 minutes' distance from the other instruments, so that anything like punctuality in the readings of all the instruments is impracticable. * * * * I found the barometer hung in a bad light for reading, and have therefore changed its position and re-verified its readings.

The instruments were all found to be in good condition. The thermometers are exposed in a louvred shed similar to that at Jubbulpore, and suspended on a board. A cage should be substituted for this.

The sun thermometer is not less than 8 feet 5 inches above the ground level, affording another instance of the neglect of the standing rules, which provide that the height be 4 feet. The stand should be removed from the brick-work structure in which it is now fixed, and fixed in the ground, with due regard to the above proviso. The wind vane and anemometer are too near the ground.* * * *

SEONI.—This station also has not been previously inspected by any Meteorological Reporter. The position of the observatory is good, but in the condition and exposure of one or two of the instruments there is somewhat to be desired. The barometer, which appears to have been long in use, was hung in a very bad light, and the exterior of the tube so dirty that anything like accurate reading was impossible. Moreover, instead of being freely suspended, it was rigidly fixed, and not vertical, and the top of the column so much above the observer's eye that he could not have set the vernier properly, even had the mercury surface been distinct. Attention to all these points is drawn with some repetition and emphasis in the printed Instructions, and also in the sheet of "Memoranda for the guidance of Officers inspecting Observatories;" but this sheet, instead of being pasted on a board and suspended in the office room, as directed, seems to have been left aside and mislaid, and was not forthcoming. I cleaned and re-suspended the barometer in a proper position, and I trust that, when the new instrument which has been sent to replace it shall arrive, attention will be duly paid to the points hitherto neglected.

The wind vane and anemometer are in a good position, and the direction of the former very nearly true.

The shaded thermometers have hitherto been exposed in a louvred shed, as at Jubbulpore and Saugor; but this is in bad repair, and a new shed on the authorised pattern is being erected in a very good position close by.

The thermometers have hitherto been suspended too high above the ground. The proper elevation of the bulbs, according to the Instructions, is between 3 feet 9 inches and 4 feet 3 inches. At present, the dry and wet bulb thermometers are so much above the observer's eye, that all his readings

are vitiated by parallactic errors. The hygrometer, moreover, appears to have been suspended in the box in which it is packed, and, what is worse, the lid of the box has been kept closed, except when opened for the readings. The result is, that they have been kept in an artificial vapour-bath, and must show too high a humidity and too low a temperature. They should be at once taken out of the box and suspended apart, as directed in the printed Instructions.

The sun thermometer is not in very good order; but this is not the fault of the observer. He was shewn how trustworthy readings might be recorded with it notwithstanding. The remaining instruments were found to be in good condition.

NAGPUR.—This observatory was visited by myself originally in 1875, and is in the same position, but has received several improvements. A thermometer shed of the authorised pattern has been substituted for the louvred shed formerly in use; the barometer is kept in a masonry building outside the jail walls, and there are some other changes. All the instruments and appliances were found to be in excellent order, and the only point in which a change is desirable is the elevation of the anemometer and wind vane, which are still too low, though they have been raised.****

The barometer cistern was cleaned and the mercury purified.

CHANDA.—This observatory has not been inspected before by any officer of this Department. The situation appears to be as good as any that could be selected in the immediate neighbourhood of Chanda, being comparatively high and free from large trees.

I have for some time past doubted the validity either of the barometric readings as reported, or alternatively, the elevation of the barometer, since, on correcting the former and reducing them to sea-level from the assigned elevation, the readings have been found uniformly too high as compared with those of surrounding stations. On visiting the observatory this discrepancy was explained. Unlike the observers at other third class stations, the observer had been furnished with the correction of his barometer, and, disregarding the printed Instructions, paragraph 148 (the direction in question being italicised), and rule 69, he had been accustomed to apply the correction to every reading of his barometer before writing it down on the B form.

The barometer was in a room well fitted for it, but not suspended in a good light, and I therefore removed it to a better position at the same elevation, rendering it vertical by the test of a plumb-line. There is another barometer in the room in good condition, but not at present in use. I desired the observer to record readings of both instruments simultaneously for a month, and to forward them to me, in order that the relative value of the two instruments may be known; and that in case of accident to the standard, the other may be brought into use without introducing any error.

The thermometers were all in good order, and suspended on a bar (not in the usual cage) under an excellent shed of the regulation pattern. A cage sent from Calcutta had just been received, and I showed the observer where and at what elevation (*viz.* 3 feet 9 inches) it should be set up.

The sun thermometer stand requires a coat of paint.

The wind vane is in good position, on a high post formerly used for the telegraph wire, and the points are fairly true, but the anemometer is fixed on a post about 10 feet high, with projecting foot pieces for ascending, but which is so rotten, that any attempt to ascend the post for the purpose of reading the instrument would certainly bring the whole down. I found the observer did not know how to read the instrument properly. Instead of taking the lower of the two figures near the index of each wheel, he took the higher.

KHANDWA.—This has been inspected twice previously, *viz.*, by myself in 1875, and by Mr. Eliot in 1878. There is but little requiring notice, beyond the fact that the thermometer shed is in very bad repair, and requires immediate re-thatching, and that it would be a great improvement if the barometer could be kept in the immediate proximity of the other instruments. At present, being fully half a mile distant, it must take the observer at least ten minutes to proceed from the one to the other, and anything like punctuality in the reading is of course out of the question.

The instruments were all in good order, but the barometer, which is an old one, received an injury while being removed from its suspension, and the fiducial point being detached, the cistern level can no longer be adjusted. Another barometer is therefore being sent up from Calcutta.

(Sd.) HENRY F. BLANFORD

APPENDIX F.

Extract from the Administration Report of the Meteorological Reporter for Western India.

THE Meteorological Department of Western India has hitherto been almost exclusively employed in the regular observation and registration of the pressure, temperature, humidity, and movement of the atmosphere, together with the rainfall and the general character of the weather; that is to say in the collection of all the information which is necessary for the development of the *climatology* of this portion of the country.

Numerous small meteorological observatories have been established; all have been provided with good verified instruments, observers have been trained, and a system of periodical inspection has been instituted. The registers are collected in the central office in Bombay, where they are carefully examined, corrected, and reduced, and so prepared for incorporation in the general annual reports of the Indian Meteorological Department.

The observations recorded at the numerous observatories in Western and Southern India are at present only available for the development of the climatology of the country, but if they were telegraphed daily to Bombay, they would also become available for the prognostication of storms No storm-warning system has, however, been established up to the present time, April 1880, partly because of the expense that would be involved, but mainly because the weather in the Indian seas, and particularly on the west coast, is, compared with that experienced in higher latitudes, usually of a settled character; and the necessity for a storm-warning system is consequently not kept constantly in view by the frequent occurrence of destructive gales. In the month of May 1879, however, a violent storm swept the western coast, causing the loss of many lives, and of property, which is estimated to have been worth upwards of £500,000 sterling. This deplorable event has been the means of again bringing the subject to notice, and proposals for the establishment of a storm-warning system for the Bombay coast are now under the consideration of Government. [1]

OBSERVATORIES.

During the year 1879-80 more or less complete registers have been received from twenty-two observatories, exclusive of Bombay. These are enumerated in the following list, which also shows the names of the supervising officers and of the observers who have officiated at the various observatories during the year:—

Names of the Superintendents and Observers at the Meteorological Observatories in Western India during the year 1879-80.

Observatory.	Officer in charge.	Date.		Observer.	Date.	
		From	To		From	To
Kurrachee ...	Surgeon-Major J. Grant ...	1st April 1879...	7th Oct. 1879 ...	Lance Corporal James Ayling.	1st April 1879 ...	9th March 1880
	Surgeon Foss ...	8th Oct. „ ...	10th Oct. „ ...	Lance Corporal John Boyle ...	10th March 1880	31st March 1880
	Surgeon-Major A. F. Preston ...	11th Oct. „ ...	9th Feb. 1880...			
	„ Jobson ...	10th Feb. 1880...	9th March „ ...			
	„ G. Hare ...	10th March „ ...	31st March „ ...			
Deesa ...	„ C. F. Richards ...	1st April 1879...	26th Jan. „ ...	Private James Bruce ...	1st April 1879 ...	31st „ „
	„ J. Williamson ...	27th Jan. 1880...	7th Feb. „ ...			
	„ G. Hare ...	8th Feb. „ ...	8th March „ ...			
	„ F. W. L. Hodder ...	9th March „ ...	31st March „ ...			
Yerrowda ...	Surgeon S. M. Salaman ...	1st June 1879...	13th Dec. 1879...	Private T. W. Harriott ...	1st June „ ...	31st „ „
	„ J. P. Greany ...	14th Dec. „ ...	28th Feb. 1880...			
	„ S. M. Salaman ...	29th Feb. 1880...	31st March „ ...			
Poona (old observatory).	Surgeon-Major J. Land ...	1st April 1879...	24th Sep. 1879...	Private T. W. Harriott ...	1st April „ ...	31st May 1879.
	„ W. Tanner ...	25th Sep. „ ...	25th Feb. 1880...	Hospital Sergeant J. Tait ...	1st June „ ...	24th Feb. 1880.

[1] The establishment of a storm-warning system has recently received the sanction of Government.

Names of the Superintendents and Observers at the Meteorological Observatories in Western India during the year 1879-80—concluded.

Observatory.	Officer in charge.	Date. From	Date. To	Observer.	Date. From	Date. To
Poona (old observatory).	Surgeon-Major J. D. Edge ...	2nd March 1880...	15th March 1880	Hospital Assistant R. Koyet...	4th March 1880	31st March 1880.
	„ G. Ashton ...	16th „ „ ...	31st „ „ ...			
Belgaum ...	„ A. R. Hudson ...	1st April 1879...	2nd Nov. 1879...	Private H. P. Stephens ...	4th April 1879	28th Dec. 1879.
	„ B. Butland ...	3rd Nov. „ ...	5th Feb. 1880...	„ H. Farmer ...	29th Dec. „	31st March 1880.
	„ J. F. Brodie ...	6th Feb. 1880...	31st March „ ...			
Jacobabad ...	Surgeon M. L. Bartholomeuz ...	1st April 1879...	13th Feb. „ ...	Hari Bhau ...	1st April „ ...	31st „ „
	„ J. M. Cloghry ...	14th Feb. 1880...	31st March „ ...			
Bickaneer ...	No Superintendent ...	.....	.....	Ram Lal ...	1st „ „ ...	31st „ „
Satara ...	W. Strachan, Esq. ...	1st April 1879 ...	7th March 1880...	Kazi Ahmed ...	1st „ „ ...	7th „ „
	Superintendent of Cotton Experiments.					
Hyderabad, Sind.	Surgeon-Major A. F. Preston ...	1st „ „ ...	20th Oct. 1879 ...	Assistant Apothecary D. Fonseca.	1st „ „ ...	11th Sep. 1879.
	„ J. McNamard ...	21st Oct, „ ...	7th Feb. 1880...	Hospital Assistant C. A. Pruce.	12th Sept. „ ...	31st March 1880.
	„ P. W. Cochell ...	8th Feb. 1880...	10th March „ ...			
	„ Anderson ...	11th March „ ...	17th „ „ ...			
	„ D. Hughes ...	18th „ „ ...	28th „ „ ...			
	„ J. H. Keith ...	29th „ „ ...	31st „ „ ...			
Bhuj ...	Surgeon A. F. Sargent ...	1st April 1879 ...	31st „ „ ...	Narayan Mane ...	1st April „ ...	31st „ „
Mount Abu...	Surgeon-Major A. Moffit ...	1st „ „ ...	7th Jan. „ ...	Hospital Sergeant Joseph Briggs.	1st „ „ ...	31st „ „
	Assistant Apothecary J. McIntyre...	8th Jan. 1880...	21st „ „ ...			
	Surgeon-Major R. Macmullen ...	22nd „ „ ...	31st March „ ...			
Neemuch ...	„ R. H. Bolton ...	1st April 1879...	7th April 1879 ...	T. Bachu ...	1st „ „ ...	31st „ „
	„ T. O'Farrel ...	8th „ „ ...	15th „ „ ...			
	„ R. H. Bolton ...	16th „ „ ...	30th Sept. „ ...			
	„ T. O'Farrel ...	1st Oct. „ ...	7th Jan. 1880...			
	„ T. Boyd ...	8th Jan. 1880...	31st March „ ...			
Indore ...	Dr. T. Beaumont ...	1st April 1879...	31st „ „ ...	Gopal Rao ...	1st „ „ ...	31st „ „
Rajkot ...	Surgeon H. W. Boyd ...	1st „ „ ...	19th April 1879...	Sheik Dadu Mya ...	1st „ „ ...	31st „ „
	Surgeon-Major R. H. Batty ...	20th „ „ ...	27th „ „ ...			
	Surgeon H. W. Boyd ...	28th „ „ ...	4th June „ ...			
	Surgeon-Major R. H. Batty ...	5th June „ ...	11th July „ ...			
	Surgeon H. P. Jervis ...	12th July „ ...	7th March 1880...			
	Surgeon-Major R. H. Batty ...	8th March 1880...	30th „ „ ...			
	Surgeon H. P. Jervis ...	31st „ „ ...	31st „ „ ...			
Surat ...	„ J. F. Keith ...	1st April 1879...	21st Jan. „ ...			
	Surgeon-Major C. Joynt ...	22nd Jan. 1880...	31st March „ ...	Balu Khanju ...	1st „ „ ...	12th Dec. 1879.
Akola ...	Surgeon T. Hume ...	1st April 1879...	31st „ „ ...	Dhunjibhai Motabhai ...	13th Dec. „ ...	31st March 1880.
Amraoti ...	Apothecary G. E. Kind ...	1st „ „ ...	4th Nov. 1879...	Samuel Gregory ...	1st April „ ...	31st „ „
	First Class Hospital Assistant Maula Bux.	5th Nov. „ ...	14th „ „ ...	Bukaram Pandurang ...	1st „ „ ...	31st „ „
	Apothecary G. E. Kind ...	15th „ „ ...	31st March 1880...			
Chikalda ...	No Superintendent ...	...	...	Hospital Assistant Amirulla Khan.	1st „ „ ...	31st „ „
Buldana ...	Honorary Surgeon A. B. Menasse ...	1st April 1879 ...	31st March 1880...	Pandurang Krishnaji ...	1st „ „ ...	31st „ „
Malegaon ...	Surgeon B. N. Koyaji ...	1st „ „ ...	31st „ „ ...	Bhagu Mahadev ...	1st „ „ ...	12th Aug. 1879.
				Ramchandra Waman ...	13th Aug. „ ...	18th Sept. „
				Bhagu Mahadev ...	19th Sept. „	7th Jan. 1880.
				Ramchandra Waman ...	8th Jan. 1880	31st March „
Sholapur ...	„ H. M. Calman ...	1st „ „ ...	31st „ „ ...	Rhamim Sutkalji ...	1st April 1879	9th Jan. „
				Parashram Swami ...	10th Jan. 1880	31st March „
Ratnagiri ...	„ F. C. Barker ...	1st „ „ ...	31st „ „ ...	Mahadev Kadam ...	1st April 1879	31st „ „
Karwar ...	R. G. C. Westbrook, Esq., Port Officer	1st „ „ ...	31st „ „ ...	G. W. M. D'Aranjo ...	1st „ „ ...	31st „ „

A new observatory was opened at Yerrowda, near Poona, in June 1879, in a more exposed situation than that occupied by the old one. The old observatory will not be closed, however, until simultaneous observations at both new and old observatories have been recorded for one complete year, so as to render it possible to connect the new with the old series of observations.

At Belgaum, also, what is virtually a new observatory has been established, although the situation has not been altered; for, in July 1879, the registration of the readings of a new set of instruments under uniform conditions of exposure was commenced.

The old observatory at Deesa was also closed at the end of October 1879, after having been worked simultaneously with the new one for a period of twelve continuous months.

The observatory at Salara was also closed on the 8th March 1880, the volunteer observer having removed to Hyderabad, where an observatory already exists.

A very important new observatory, furnished with good verified instruments from Bombay, has been established by Dr. C. T. Peters at Zanzibar, on the East Coast of Africa. Recent investigation having shown that the peculiar characteristics of the monsoons of different years are intimately related to the general meteorological conditions of the Indian Ocean, it becomes of great importance that early and reliable information of these conditions should be obtained. As Zanzibar is now in telegraphic communication with Bombay, and as Dr. Peters took great pains before leaving Bombay to acquaint himself with the methods of observation and reduction, it has now become possible to obtain such information.

Inspection of Observatories.

During the past year, I have inspected the observatories at Poona, Sholapur, Karwar, Belgaum, Ratnagiri, Indore, and Neemuch. The observatory at Bickaneer has been inspected by Surgeon-Major G. S. Sutherland, Superintendent-General of Dispensaries, Rajputana, and the one at Akola by Mr. H. F. Blanford, Meteorological Reporter to the Government of India. In the course of my inspections the following points always receive particular attention: 1st, each instrument is carefully examined while in position, to see that there are no defects, either in the instrument itself or in the manner in which it is exposed; 2nd, the barometer, dry and wet bulb thermometers, maximum and minimum thermometers, and terrestrial radiation thermometer, are carefully compared with portable standard instruments at one point of their scales, in order to verify their accuracy; 3rd, a comparative set of readings of the various instruments is taken with the observer to test his ability to accurately read and record their indications; and finally, any defect which may be discovered is rectified, and the observer is instructed how to prevent its recurrence.

Poona.—The old observatory at this station was found to be in a satisfactory condition. The new one at the Yerrowda Jail, near Poona, was also working well in all ordinary respects. Everything connected with this observatory was remarkably neat and orderly, and the same may be said of the observer's work, which bears a high character for accuracy. The small embossing anemometer has, however, in spite of very great care and attention on the part of the observer, failed to give satisfaction. Although the workmanship of this instrument is excellent, its design appears to me to be radically defective; for whenever the wind is very strong or blows in gusts, the coincidence which should always be maintained between the vane and the recording apparatus is destroyed, and the record thereby rendered valueless. Attempts have been made to overcome this defect by increasing the tension of the chain which connects the vane to the recording apparatus, but this seriously diminishes the sensitiveness of the vane to light winds. Another theoretical defect is that the instrument fails to record the duration of calms. Confusion is thus introduced into the time scale, and the record ceases to be of use for all investigations in which time forms an element. I do not see how these and other defects can be rectified without some radical alteration of the instrument.

Sholapur.—Everything at this observatory was found to be in serviceable condition, and most of the instruments were in very good order. The only defects—and these slight ones—were, that the

shaft of the wind vane had worked a little loose, and the surface of the mercury in the barometer cistern had, by lapse of time, become somewhat dull. For the wind vane, a small flag and a magnetic compass were substituted, and the mercury in the barometer cistern was cleaned. The observer was evidently well qualified for his work.

Karwar.—Everything was found in good order. The observer is careful and competent, but he has probably more work in hand than is advisable, having, in addition to his primary duties as Port Office Clerk, to attend to the Tidal Observatory under the Survey Department, as well as to the Meteorological Observatory, the whole requiring almost continuous attention from sunrise to sunset.

Belgaum.—With the exception of the old wind vane, the orientation of which was found from one to two points in error, everything was in good order.

Ratnagiri.—All was in good order at this observatory. The only point calling for remark was that the thatch of the thermometer shed, although renewed just before the monsoon, was in some places not quite so thick as is desirable.

Indore.—The condition of this observatory was found to be satisfactory in all respects.

Neemuch.—Everything was found in serviceable condition. The anemometer was, however, much worn, and was replaced by a new instrument which was erected under my own supervision.

Bickaneer.—As already stated, this observatory was inspected by Dr. Sutherland, who, at the time of his visit, found the wet bulb thermometer out of order. A new one was sent from Bombay shortly afterwards. Of the thermometer shed Dr. Sutherland writes: "The instrument shed is badly constructed, being supported on twelve massive pillars of masonry, each $2\frac{1}{2} \times 2$ feet, and about 7 feet high. The roof is too thin, being made of three thin layers of thatching grass. It covers an area of 20 x 20 feet, and is about 12 feet high." He also states that "Hospital Assistant Ram Lal is able to adjust and read the vernier scale of the barometer correctly; but he has never made any adjustment of the level of the mercury in the cistern." "The barometer stands in the shed above described with the thermometers. The glass of the cistern is tarnished, and it is difficult, as it now stands, to see the point of the peg to which the level of the mercury should be adjusted. It appears to be buried some distance in the mercury which is nearly on a level with the upper edge of the opening in the iron case of the cistern. I advised the observer, as he had never made this adjustment, not to do so without orders from you. I did not myself touch the screw. All the other instruments named were in good order and properly placed." The omission to adjust the level of the mercury in the cistern of the barometer will make it necessary to apply corrections to the reading of this instrument. A new barometer has therefore been sent with the double object of determining these corrections and of ensuring greater accuracy in future.

Akola.—Of this observatory Mr. Blanford reports: "Everything satisfactory, except that the wind vane is worn out and useless. Reading lens required for observer. The thermometer cage should not be more than 3 feet 6 inches above the ground."

The following table gives the results of the comparisons of the various instruments with the standards at the time of inspection, the sign + indicating that the instrument read higher than the standard, and the sign — that it read lower:—

Stations.	Poona, Wanowree.	Poona, Yerrowda.	Sholapur.	Karwar.	Belgaum (old).	Belgaum (new).	Ratnagiri.	Indore.	Neemuch.
	Inch	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
Barometer ...	+·002	—·002	+·001	+·001	—·004	—·005	—·005	·009	+·003
	°	°	°	°	°	°	°	°	°
Dry bulb ...	0·0	+0·1	—0·1	+0·4	+0·1	0·0	0·0	+0·2	+0·1
Wet bulb ...	+0·2	+0·2	—0·1	0·0	+0·2	+0·1	+0·4	—0·2	0·0
Dry maximum ...	—0·4	+0·1	0·0	—0·1	...	—0·1	—0·1	0·0	—0·1
Dry minimum ...	0·0	0·0	0·0	—0·3	—0·1	—0·2	—0·1	+0·2	0·0
Wet minimum ...	—0·1	—0·2	—0·5	—0·2	+0·2	+0·2	—0·6	—0·2	—0·1
Grass minimum ...	—0·1	—0·3	—0·2	—0·2	...	+0·3	—0·4	0·0	+0·3

It will be observed from this table that the differences are often not greater than the probable error of the comparisons, which I estimate at not more than +·002 for the barometers nor above +0·2 for the thermometers. In one or two cases, the mercurial thermometers show the usual tendency to rise slightly, while some of the barometers show differences which are greater than the probable error of comparison. These I attribute to slight instrumental defects of various kinds, and they appear to me to point to the necessity of having all barometers compared at the pressures to which they will be subjected when in use; in fact, they show that it is not safe to rely upon the assumption that the index errors are constant, and can therefore be determined at any pressure.

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METEOROLOGICAL ERECTIONS.

A new thermometer shed of the standard pattern has been constructed at Belgaum, but with the exception of a few repairs, where needful, no other change has been made in the condition of any of the meteorological erections.

INSTRUMENTS AND THEIR VERIFICATION.

The instruments issued, all of which were verified at Bombay, are specified in the following table, which also shows the reason for every change:—

Instruments issued between the 1st April 1879 and the 31st March 1880.

Stations.	Barometer.	Dry Bulb of Hygrometer.	Wet Bulb of Hygrometer.	Dry Maximum.	Dry Minimum.	Wet Minimum.	Solar Thermometer.	Grass Thermometer.	Anemometer.	Total.
Jacobabad	...	...	...	...	...	...	...	[1]1	...	1
Bickaneer	...	...	[1]1	...	...	...	...	...	...	1
Hyderabad	...	...	...	...	...	...	...	...	[2]1	1
Kurrachee	...	...	...	...	...	...	...	...	[2]2	2
Bhuj	...	...	...	...	...	...	...	[1]1	[2]1	2
Deesa	...	[2]1	...	...	...	...	...	[1]1	...	2
Mount Abu	...	[2]1	...	...	...	...	...	...	...	1
Neemuch	...	...	...	...	...	...	...	[1]1	...	1
Indore	...	...	...	...	...	...	...	...	...	1
Rajkot	...	...	...	...	...	...	...	[1]1	...	1
Surat	...	[2]1	...	[1]1	...	...	[2]1	[1]2	...	4
Akola	...	...	...	...	...	...	[2]1	...	[2]1	2
Amraoti	...	...	...	...	...	...	[1]1	...	...	1
Chikalda	...	...	...	...	...	...	[1]2	...	[2]1	3
Buldana	...	...	...	...	...	...	[1]1	...	...	1
Malegaon	...	...	...	...	...	...	[2]1	...	...	1
Poona (old Observatory)	...	...	[1]1	...	[1]1	...	...	[1]1	...	3
Poona (new Observatory)	...	...	...	...	...	...	[1]1	...	...	1
Sholapur	...	...	...	[2]1	...	...	[2]1	...	...	2
Ratnagiri	...	...	...	...	...	...	...	...	...	...
Belgaum	...	[3]1	...	[2]1	...	...	...	...	[3]1	3
Karwar	...	...	...	...	...	...	...	...	...	...
Salara	...	...	...	[2]1	...	...	[1]1	...	...	2
TOTAL ...	4	...	3	3	1	...	10	8	7	36

The smallness of the number of breakages may be taken to indicate the comparative carefulness of the observers, but mere instrumental derangements and exchanges of instruments are ordinarily due to circumstances over which the observers have little or no control. The frequent change of barometers is very undesirable, but unavoidable until instruments of a better pattern are supplied, those at present in use being all liable, sooner or later, to become deranged. In my report for the year 1877-78, I pointed out the defects of these instruments and the improvements that are required.

* * *

1 To supply the place of a broken instrument.
2 To supply the place of a deranged instrument.
3 To supply the place of an instrument returned for examination.

TRAINING OF OBSERVERS.

Hospital Assistant Dhunjibhai Motabhai has been trained at the Bombay Office to fill the post of observer at Surat, but all other new observers have been taught by their predecessors at the respective stations, or by myself at the time of inspection.

METHODS OF OBSERVATION AND REDUCTION.

These remain the same as in the previous year, with the exception that magnetic compasses with circles divided into sixteen parts have been brought into general use for observing the wind direction, and the method of estimating the direction by means of a cross has been entirely discontinued. The distribution of the observations among the different points has, in consequence, become much more uniform than when the direction was merely estimated, and when there was always a tendency on the part of the observers to give undue prominence to the eight directions N, NE, &c., to the comparative neglect of the intermediate directions NNE, ENE, &c.

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CHARACTER OF THE METEOROLOGICAL REGISTERS OF THE YEAR 1879.

With one or two trifling exceptions, the registers from all the observatories have been accurate and trustworthy throughout the whole of the year. The only apparent shortcomings of any moment were in the wind direction observations at Malegaon, during a portion of the month of August (when the new observer does not appear to have been sufficiently well acquainted with this part of his duty), and in the anemometer readings at Hyderabad (Sind), for a few days in the month of July, immediately after a new instrument of a different pattern from the old had been supplied. The daily comparison of the observations of each station with those of surrounding stations, shows clearly that the observers habitually read and record the indications of their instruments with perfect honesty; for, during the whole of the year, the only observations which would not satisfactorily bear this searching test were those above mentioned, and those of four days in the month of February from the old observatory at Poona. These latter observations were recorded by a temporary observer near the end of his term of office, and being doubtful, have been rejected.

* * * * * * * * *

OFFICE ESTABLISHMENT.

Throughout the year, the office establishment remained the same as in the previous year. It consists of five clerks on salaries varying from Rs. 30 to Rs. 45 per mensem, and it has to deal more or less completely with the observations of twenty-three observatories, from nineteen of which no assistance whatever is rendered by the observers, who merely register the uncorrected readings of their instruments.

WORK OF THE OFFICE.

For want of additional assistance, the work of the office has been almost entirely restricted to the routine work of reducing and preparing the observations for incorporation in the general annual reports of the Department. The monthly returns have been regularly forwarded to Calcutta, and abstracts of them have been published in the *Bombay Government Gazette*.

A brief sketch of the meteorology of the Bombay Presidency in 1878 was prepared for incorporation in the general administration report of the Presidency. In this paper, as in the sketch for the preceding year, special attention was drawn to the remarkable *uniformity* of the barometric variations over wide areas, and to the fact that these variations are accompanied by an inverse variation of the rainfall of the whole Presidency. From this relation, it was inferred that the copiousness or scantiness of the summer rains, as a whole, depends chiefly upon the general state of atmospheric pressure over the tropical portions of India and the Indian Ocean, rather than upon mere variations of the barometric

The registers of two of these observatories were communicated to the Central Office, uncorrected and unreduced.—H F.B.

gradients of the monsoon season; although, as was pointed out in the sketch for 1876, these latter are intimately connected with the *local distribution* of the rains.

* * * * * *

F. CHAMBERS,
Meteorological Reporter for Western India.

METEOROLOGICAL OFFICE BOMBAY,
The 29th June 1880.

APPENDIX G.

Statement showing the Names of Superintendents and Observers at the several Observatories of British Burma during the year 1879-80.

Stations.	Names.	Appointment.	Remarks.
Rangoon	Surgeon G. A. Dundas	Superintendent.	
	G. W. Bird	Observer	From January 1879 to 31st May 1879.
	A. Sarfas	Ditto	„ 1st June 1879 to 31st March 1880.
	R. Donald	Assistant Observer.	
Moulmein	Surgeon-Major W. F. DeFabeck, M.D.	Superintendent.	
	Hospital Assistant L. Hilbert	Observer.	
Thyetmyo	Surgeon H. J. Hazlett, I.M.D.	Superintendent	From 1st April 1879 to 5th May 1879.
	Surgeon O. Baker, I.M.D.	Ditto	„ 16th May 1879 to 31st March 1880.
	Hospital Assistant Ahmed Ally	Observer.	
Toungh9o	Surgeon-Major R. F. Power, M. D.	Superintendent.	
	Hospital Assistant J. Paul	Observer.	
Bassein	Civil Medical Officer R. S. Dawson	Superintendent.	
	Ahsoon	Observer.	
Mergui	Surgeon R. S. Dawson, M.D.	Superintendent	From 1st to 7th April 1879.
	Assistant Surgeon Davendra Nath Roy.	Ditto	„ 8th April 1879 to 31st March 1880.
	Mahomed Cassim	Observer.	

APPENDIX H.

List of Recipients of the Publications of the Meteorological Office

Adelaide	Director of the Meteorological Observatory.
Agra	Editor of the *Delhi Gazette*.
Ajmere	Secretary to the Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Le Général Commandant Superieur du Genie en Algerie.
Allahabad	Secretary to Government, North-Western Provinces and Oudh. Meteorological Reporter, ditto ditto. Sanitary Commissioner, ditto ditto. Editor of the *Pioneer*.
Amsterdam	Secretary to the Royal Academy of Sciences.
Bangalore	Secretary to the Chief Commissioner, Mysore and Coorg. Conservator of Forests, Mysore and Coorg.
Batavia, Java	Director of the Meteorological Observatory.
Berlin	Director of the Meteorological Institute.
Bombay	Secretary to the Government of Bombay. Meteorological Reporter for Western India. Superintendent of the Colaba Observatory. Sanitary Commissioner with the Government of Bombay. Registrar of the Bombay University. Secretary to the Asiatic Society of Bombay. Superintendent, Bombay Sassoon Mechanics' Institute. Secretary to the Geographical Society of Bombay. Editor of the *Bombay Gazette*. Ditto *Bombay Times of India*. Principal of the Elphinstone College.
Brisbane, Queensland	Superintendent of the Observatory.
Brussels	Secretary to the Royal Academy of Sciences. Director of the Observatoire Royal.
Budapesth, Hungary	Director of the Observatory.
Calcutta	Secretary of State for India (through Home, Revenue, and Agricultura Department. Secretary to the Government of India, Home, Revenue, and Agricultural Department. Secretary to the Government of India, Public Works Department. Ditto ditto, Foreign Department. Ditto ditto, Department of Finance and Commerce. Secretary to the Government of India, Military Department. Private Secretary to His Excellency the Viceroy. Secretary to the Government of Bengal, General Department. Surveyor-General of India. Superintendent, Geological Survey of India. Sanitary Commissioner with the Government of India. Ditto to the ditto of Bengal. Superintendent, Botanic Gardens, Calcutta. Inspector-General of Forests with the Government of India. Secretary to the Surgeon-General, Indian Medical Department. Secretary to the Asiatic Society of Bengal. Librarian, Indian Museum Library. Registrar of the Calcutta University. Principal of the Presidency College. Librarian, Public Library. Editor of the *Calcutta Review*.

Calcutta	Editor of the *Statesman and Friend of India.*
	Ditto *Englishman.*
	Ditto *Indian Daily News.*
	Ditto *Hindoo Patriot.*
	Ditto *Indian Agriculturist.*
	Ditto *Indian Forester.*
	Revd. E. Lafont, S.J.
Cambridge	Librarian of the University Library.
Cambridge, Massachusetts	Ditto Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Germany	Director of the Baden Meteorological Observatory.
Chatham	Librarian, Royal Engineers' Library.
Chikalda	Deputy Conservator of Forests, Berar.
Christiania	Director of the Nrske Meteorologiske Institute.
	Ditto of the Royal Observatory.
Colombo	Editor of the *Ceylon Times.*
	Ditto *Ceylon Observer.*
	Surveyor-General of Ceylon.
Constantinople	Director of the Observatoire Imperial Meteorologique.
Copenhagen	Secretary to the Danske Meteorologiske Institut.
	Ditto Royal Danish Academy of Sciences.
Darjeeling	Conservator of Forests, Government of Bengal.
Dehra Dun	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Edinburgh	Secretary to the Scottish Meteorological Society.
	Astronomer Royal for Scotland, Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Goa	Director-General, Royal Observatory.
Guatemala	Director of the Observatorio Meteorologico del Institute Nacional de Guatemala.
Hamburgh	Director of the Nord Deutsche Seewarte.
Havana	Ditto Real Collegio de Belen.
Hong-Kong	Superintendent, Government Civil Hospital.
Indore	First Assistant Agent to the Governor General for Central India, in charge of the Residency.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests. Bombay, Sind Division.
Lahore	Secretary to the Government of the Punjab.
	Meteorological Reporter, ditto.
	Sanitary Commissioner, ditto.
	Conservator of Forests, ditto.
	Editor of the *Indian Public Opinion.*
Leipzig	Director of the Observatory.
Lisbon	Director of the Observatoire de Infante D'Luiz
	Secretary to the Academy of Sciences.
London	Secretary to the Meteorological Council.
	Ditto Royal Society.
	Ditto Royal Asiatic Society.
	Ditto Society of Arts.
	Ditto Meteorological Society.
	Librarian, Royal School of Mines.
	Ditto, Admiralty Library.
	Ditto, United Service Museum.
	Chief Librarian, British Museum.
	Editor of the *Philosophical Magazine.*
	Ditto *Athenæum.*
	Ditto *Nature.*
	Ditto *Symons's Monthly Meteorological Magazine.*
	Ditto *Westminister Review.*
	Ditto *Quarterly Review.*

Madras	Secretary to the Government of Madras.
	Meteorological Reporter, ditto.
	Government Astronomer, Madras.
	Sanitary Commissioner, Government of Madras.
	Registrar of the Madras University.
	Editor of the *Madras Times.*
	Ditto *Madras Athenæum.*
	Superintendent, Government Central Museum.
Madrid	Director of the Royal Observatory.
Manchester	Secretary to the Literary and Philosophical Society.
Mauritius	Ditto Meteorological Society.
Melbourne, Victoria	Director of the Observatory.
	Librarian of the University Library.
Mexico	Director of the Central Meteorological Observatory.
Milan	Ditto Royal Astronomical Observatory.
Munich	Ditto Royal Observatory.
	Ditto Royal Bavarian Academy of Sciences.
	President, Geographical Society.
Nagpur	Secretary to the Chief Commissioner, Central Provinces.
	Deputy Surgeon-General, ditto.
	Conservator of Forests, ditto.
	Inspector-General of Education, ditto.
Naini Tal	Conservator of Forests, North-Western Provinces and Oudh.
New Haven, Connecticut	Secretary to the Connecticut Academy of Arts and Sciences.
	Editors of the *American Journal of Sciences.*
New York, U. S.	Director of the Central Park Observatory.
Ootacamund	Conservator of Forests, Government of Madras.
	Editor of the *South of India Observer.*
Oxford	Librarian of the Radcliffe Library.
	Radcliffe Observer, Radcliffe Observatory.
Paris	Director, Observatoire Physique Central de Montsouris.
	Editor of *La Nature.*
	Director of the Physical Observatory. Meudon.
	Ditto Bureau Central Meteorologique.
Perpignan, France	President, Commission Meteorol. des Pyrénées Orientales.
Perth, W. Australia	Surveyor-General.
Pesaro, Italy	Director of the Royal Observatory.
Philadelphia	Secretary to the Franklin Institute.
Poona	Conservator of Forests, Bombay, Northern Division.
Prag, Bohemia	Director of the Observatory.
Rangoon	Secretary to the Chief Commissioner, British Burma.
	Sanitary Commissioner, ditto.
	Conservator of Forests, ditto.
	Editor of the *Rangoon Times.*
Rome	Director, Meteorological Office (Ministry of Agriculture).
Saharanpur	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Secretary to the Chief Commissioner, Assam.
	Deputy Conservator of Forests, ditto.
Singapore	Colonial Surgeon, Straits Settlements.
Stockholm	Director of the Nautisk Meteorologiska Byran.
St. Petersburg	Ditto Observatoire Physique Central.
Strasbourg	Librarian, Imperial University Library.
Sydney	Director of the Observatory.
	Librarian of the University Library.
Syracuse, Sicily	Director of the Royal Meteorological Observatory.
Tasmania	Secretary to the Royal Society.
Tiflis, Russia	Director of the Physical Observatory.

Tokio, Japan	Director of the Imperial Mining Office.
Toronto, Canada	Ditto Magnetical and Meteorological Observatory.
Turin	Ditto R. Osservatorio Astronomico di Torino.
Upsala, Sweden	Ditto Meteorological Observatory.
Utrecht	Secretary to the Royal Dutch Meteorological Institute.
Victoria	President of the Public Library.
Vienna	Director of the K. K. Central Anstalt für Meteorologie und Erdmagnetismus.
	Ditto K. K. Geologische Reichsanstalt.
	Secretary to the Imperial Academy of Sciences.
Vizagapatam	Dr. J. Hann.
	A. V. Nursingrow, Esq.
Washington, U. S.	Chief Signal Officer, United States Army.
	Secretary to the Smithsonian Institution.
	Director of the Naval Observatory.
	Ditto Hydrographic Office.
	Professor Cleveland Abbe, Signal Office.
Wellington, New Zealand ...	Director of the Observatory.
Woolwich	Librarian of the Royal Artillery Library.
Zi-ka-wei, Shanghai	Director of the Magnetical and Meteorological Observatory.
Zurich	Ditto Central Meteorological Institute.

Govt. Central Press,—No. 57 Meteor. 11-12-'80,—400.

REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1880-81.

IN the report for last year, I gave a general review of the progress of the department, from the date of its establishment in 1875, up to March 1880. In the present report, therefore, it will suffice to give an account of the operations of the past year, and these comprise but little beyond the steady working of the system, already elaborated in previous years, together with such slight extensions as have been necessitated by its development. As in former reports, I shall preface the detailed account of the system of observation and its results, by a short notice of some matters of special interest, which have been objects of attention during the year.

FAMINE COMMISSION REPORT.—In the introductory chapter of the Famine Commissioners' Report, after giving a summary of what is known respecting the distribution of rainfall in India, and the variations to which it is subject, the Commissioners remark:—"As, at present, no power exists of foreseeing the atmospheric changes effective in producing the rainfall, or of determining beforehand its probable amount in any season, such as would admit of timely precautions being taken against impending drought, the necessity becomes the greater for watching with close attention the daily progress of each season as it passes; for ascertaining, with accuracy and promptitude, the actual quantity of rain in all parts of the country; and for forming the best and earliest judgment possible from the facts as they occur, whether the supply will be sufficient or otherwise. For the present, at least, as far as the rainfall directly affects the subject under consideration, these are the only precautions that appear possible. Within the last few years, a very satisfactory system of meteorological observations has been established all over British India, and, in our opinion, it is of primary importance that it shall be maintained in complete efficiency, and shall so far be strengthened and improved, as to ensure the early and punctual supply of information to the executive Governments, and to the officials in all departments concerned with the agriculture of the country, or the preparations required to meet famines, as to the actual progress of the periodical seasons of rain in all parts of the provinces, for which these Governments or officers are respectively responsible. So far as it may become possible, with the advance of knowledge, to form a forecast of the future, such aids should be made use of, though with due caution.

"We are also satisfied of the importance of the diffusion of more sound and accurate knowledge of the causes and mode of occurrence of the periodical rains, on which the well being of India is so largely dependent; not only among the officers of the Government, but also among all classes of the community. Any measures which the Government may find possible, with a view to the publication and diffusion of such knowledge cannot fail to be highly beneficial."

I give priority to these extracts, because, while liberally recognising the utility of what has been already accomplished in meteorological investigation, they give emphatic expression to a principle which was enunciated in paragraphs 43 to 46 of the report on the re-organisation of the Indian Meteorological Department in 1875, and which has since been kept steadily in view, as giving specific expression to what is the chief end and aim of the department. In defining the objects and general principles of the proposed scheme, it was observed that "the practical applications of meteorology which are most important in India are not the same as those which have chiefly engaged public attention in Europe and America; and, in some respects, the machinery requires to be modified to meet special local requirements"; and further "in all that relates to the distribution of the rainfall, and the causes that influence it, every part of India is profoundly interested, and the discovery of these laws is of the first importance among meteorological problems." It may be considered that this view has now received official endorsement.

A report on the measures to be taken for increasing the efficiency of the department (in the directions indicated in the above extracts) has already been submitted to Government, and is now under consideration. The proposals comprise the improvement of the system of daily telegraphic reports—1st, by extending the system to all observatories in the vicinity of telegraph offices; 2nd, by elaborating and improving the daily bulletins, with the addition of an illustrative chart, and descriptive remarks, which will be appended throughout the year, and not, as at present, only during the rainy season; 3rd, by expediting their preparation and issue, and by communicating summaries of the report, by telegraph, to the principal seats of Local Government in all parts of India. Further, they contemplate periodical reports on the meteorology of the current season; the establishment of some additional observatories, and measures for the improvement of the work at those already existing; the collection of information respecting the weather currently prevailing over Indian seas, and the working out of the ship observations of past years, with a view to a knowledge of the normal meteorological conditions of these seas. And lastly, some proposals are submitted, for improving the observations on solar intensity, with a view to resolving the problem of the supposed periodical variation of the solar heat, a problem which obviously lies at the basis of all meteorological research.

With respect to the diffusion of information respecting the causes and mode of occurrence of the periodical rains, some steps have already been taken, and it has been pointed out that the discussion of all the available information on the subject is now in progress, and that when this shall have been completed and the results published in the scientific serial of the department, a popular summary of the information will be undertaken with greater advantage than at present.

SOLAR PHYSICS.—The importance of observations on the varying condition of the sun's surface, and on the intensity of his radiation, is prominently noticed in the Famine

Commissioners' Report. During the past year, I received a letter from the Committee appointed by Her Majesty's Government, to advise on the methods of carrying on observations on Solar Physics, communicating the views of the Committee on solar research, and inviting my co-operation, and the communication of any observations that the department might be able to furnish. The work of photographing the solar disk having been already undertaken by the officers of the Great Trigonometrical Survey at Dehra, the attention of the Meteorological Department has been directed solely to actinometric work; to the measurement of the radiant intensity of the sun; and also, pursuant to a suggestion of Sir G. Airey, to observations of the temperature of the ground. The results of one year's observations with a Balfour Stewart's actinometer, at Alipore observatory, have been communicated to the Solar Physics' Committee, and also an abstract of the observations of the ground temperatures at Alipore. The latter have an independent value, in their relation to the temperature of the air; but judging from the results hitherto obtained, it seems doubtful whether the variations of long period, which they show in a very marked degree, depend directly on those of the solar intensity, and whether the direct influence of the latter is not outbalanced and masked by that of other atmospheric conditions, *viz.*, cloud and rainfall.

It is evident that the Calcutta atmosphere is by no means favourable for actinometric work, the haze, even when cloud is absent, being such as to determine the absorption of a large and variable proportion of the sun's heat. Nevertheless, it is desirable to continue the work, since, if inferior to that which might be performed at a station with a clear atmosphere, it may yet be of considerable value, and it is desirable, also, that actinometers, to be used in other parts of India, should be compared with that at Alipore as a local standard. An instrument of the same kind has lately been compared and sent to Mr. J. B. Henessey, M.A., F.R.S., of the Great Trigonometrical Survey, who has offered to make some observations with it at Mussooree; and another is now under comparison for Leh, a station especially recommended for the purpose by the Solar Physics' Committee. At this station Mr. Ney Elias, the British Joint Commissioner, has offered to superintend the observations, but it remains to provide a competent observer, and on this point a report has lately been submitted to Government.

RAINFALL STATISTICS.—In the annual return of the rainfall, prepared for the information of the Secretary of State, considerable tracts, comprising the Native States of Western Rajputana, of Chutia Nagpur, Jeypore, and Bastar in the east of the peninsula, and that of Hyderabad in the centre, have hitherto been either quite unrepresented, or but inadequately so, owing to the absence of registers. During the past year, steps have been taken to supply these deficiencies, and arrangements have been made, with the assistance of the Local Governments and Administrations, to establish rain-gauge stations in the Tributary Mehals of Orissa, Chutia Nagpur, South Rewah, the eastern districts of the Central Provinces, Jeypore, Bastar, and also in Khyrpore, on the borders of Sind, and an endeavour is being made to do the same in Western Rajputana. Through the assistance of the Resident of Hyderabad, rainfall registers, for the past six years, have also been obtained from several stations in Hyderabad, so that this territory is now as well represented as most other parts of India. And, quite recently, I have received from the Superintending Engineer of the Mysore Irrigation a number of additional registers for the Province of Mysore, from which a selection will be made for future returns.

With respect to some of the older provinces, it would appear that, owing to the use of untrustworthy or unsuitable gauges, certain of the returns are far below that standard of accuracy which is easily attainable even with the ordinary staff of native observers. Bengal and Madras were provided with Symons' gauges in 1863 and 1867, and these are found to furnish excellent results. But in the North-Western Provinces and, I believe, in some other Governments, gauges of the old pattern, known as Fleming's gauge, are still extensively used. The objections to this form of gauge were pointed out in the *Indian Meteorologist's Vade Mecum*, wherein it was described as follows:—"The receiver of this gauge is long and narrow, and contains a float (nearly as broad as the receiver) carrying a light brass or wooden rod, which rises as the rain accumulates, passing through a perforated bar across the mouth of the funnel. This bar serves as an index, and shows, by its intersection with the rod, the quantity of water in the receiver. The float requires a certain quantity of water to float it and bring it to the zero mark, and this quantity ought always to be kept in the gauge,—a matter requiring some attention during dry weather. Failing this, the quantity required for floatation must be ascertained and added to the quantity read off. Should the rain be too small in quantity to bring the rod to zero point, it cannot be accurately recorded. The gauge, therefore, in the hands of unskilled and inattentive persons, (and they are many) *is likely to give results always in defect of the truth*, and such is found to be the case in practice.

"The gauge is open to many other objections. If the float is dented or otherwise altered in form, or if any part has to be resoldered, the quantity of water required for floatation is altered, and this is rarely attended to."

It will be seen, therefore, that the gauge is one which gives an accurate register only when in very careful hands, whereas the simple form of gauge furnished with a measure glass, such as is used in Bengal and Madras, requires only ordinary care. How far the above condemnation of Fleming's gauge, for general use in India, is justified, is shown in the return of the rainfall of the North-Western Provinces, lately sent up by Mr. Hill, to the errors of which he draws attention in his report (Appendix B). In this return he gives the rainfall measured at the observatories (with Symons' gauges) and that measured at the same stations with the Fleming's gauges issued many years since by the Revenue Board. The following table gives a comparative view of the results:—

Rainfall in 1880.

Stations.	Observatory gauge.	Tehsil gauge.	Difference.	
	Inches.	Inches.	Inches.	Per cent.
Dehra	84·42	71·5	—12·92	—15
Roorkee	45·58	42·1	— 3·48	— 8
Meerut	45·72	43·05	— 2·67	— 6
Bareilly	29·55	28·3	— 1·25	— 4
Agra	14·77	11·8	— 2·97	—20
Allahabad	20·34	17·0	— 3·34	—16
Benares	26·34	25·4	— 0·94	— 4
Gorakhpur	44·21	44·4	+ 0·19	0
Jhansi	20·23	19·5	— 0·73	— 3
Ranikhet	57·27	54·82	— 2·45	— 4
Lucknow	17·38	14·8	— 2·58	—15

As all these are important stations, it is probable that their returns are at least equal to the average of those of the North-Western Provinces generally; and if so, it would appear that while nearly all are in defect of the truth, one-third are 15 per cent. and more, in error.

In Bombay, according to a report of Mr. C. Chambers,[1] the gauges were subjected to a rough verification in 1873, as the result of which, it appeared that those of 31 out of 171 stations were 10 per cent. and upwards in error. I am not aware whether any steps have been taken to obtain a more accurate verification, or whether the gauges found to be most erroneous have been replaced by more trustworthy instruments.

Considering the high importance of having an accurate registration of the rainfall, and that the regular meteorological observations, alone, are numerically insufficient to represent this extremely variable element of our meteorology, I think it is at least highly desirable that steps should be taken to place the registration on a more satisfactory footing, by the general adoption of a simple and trustworthy form of gauge; and none is more suitable than the little Symons' gauge adopted in Madras and Bengal.

STORM-WARNING SYSTEM, BOMBAY.—On the 18th May 1880, a system of daily telegraphic report to Bombay from stations on the coasts, for the purpose of warning the western ports of the approach of storms, received the sanction of the Government of India, and it was brought into operation on the 13th June.[2] The readings of the barometer, dry and wet bulb thermometers, wind direction and velocity, and the amount of the rainfall registered at 10 A.M., together with a brief descriptive phase indicating the character of the weather at that hour, and also during the preceding 24 hours, are telegraphed to the Meteorological Reporter at Bombay, from seven stations on the west coast, and from three on the east coast of the peninsula; the telegrams being framed in accordance with the telegraphic code devised by Messrs. Eliot and Pedlar in 1878. It is known generally, that the storms, which are felt on the west coast of India, originate in many cases over the Bay of Bengal; while it would appear from such scanty data as have been placed on record by Mr. Piddington and Dr. Buist, that others are probably generated over the Arabian Sea, between the Lakadives and the peninsula. Of such, however, little or nothing is known definitely. Of the former class, there are many cases on record; but it is at present doubtful whether, in any case, a distinct cylonic vortex traverses the peninsula, and whether such as reach the Coromandel Coast are not broken up by the hills of the peninsula to be reformed under the lea of the Malabar Coast. Such appears to have been the case in May 1879, a storm which was the immediate occasion of the proposal and sanction of the present system. The three stations on the Coromandel Coast, Negapatam, Madras, and Masulipatam, which send telegrams to

[1] The meteorology of the Bombay Presidency, p. 208.

[2] The first reports were received from the several reporting stations on the following dates:—

Surat	13th June 1880.
Kurráchee	19th " "
Kárwar	25th " "
Calicut	5th July "
Madras	1st September 1880.
Negapatam	2nd " "
Masulipatam	8th " "
Cochin	24th " "
Mangalore	1st November "
Rutnagiri	27th May 1881.

Bombay, have been included in the system, in order that the Meteorological Reporter for Western India may have early information of the occurrence of stormy weather on the east of the peninsula; and it is further provided that the Meteorological Reporter for Bengal, who receives daily telegraphic reports from the whole circuit of the coasts of the Bay, shall telegraph to Bombay notice of any appearance of the formation of a cyclone in the southern part of the Bay. The Superintendent of the Bombay system is empowered, in such cases, (and, indeed, whenever it may appear to be necessary), to call for reports from any additional stations, which may be required to enable him to watch the progress of the storm.

The telegrams are deciphered and the instrumental readings corrected and reduced in the Reporter's Office; and about 4 P.M., a copy of the weather report is forwarded to the Port Officer, Bombay, and posted in his office. The information is also furnished to two newspapers for publication.

In the event of threatening weather, a warning is sent to the Port Officer, and additional reports are called for from such of the observatories as are most favourably situated for affording important information; and if the disturbance appear to threaten any of the Bombay ports, warning telegrams are sent to them. Storm signals, consisting of a cone by day, and three lamps in a triangle by night, are exhibited on receipt of a warning, and, unless an order to lower them is received earlier, are kept displayed for 18 hours after the despatch of the warning.

It is obvious that the working of any system of storm warnings will be effective, other things being equal, in proportion to the available knowledge of the local characteristics of storms, their place of origin, the conditions under which they are formed, their habitual tracks, &c. On these points, however, very little has hitherto been recorded respecting the storms that effect the coasts of Bombay; a few brief notes by Mr. Piddington and Dr. Buist being almost the only information I was able to discover, when enquiring into the subject some time since. As, however, there appears to be some amount of information on record in some of the offices of Bombay, which may be worth collecting and discussing, I have requested Mr. Chambers to make further enquiry and to draw up a report on the subject.

STORM-WARNING SYSTEM, CALCUTTA.—From the beginning of the year under report, an important improvement in the Bengal system of reports was introduced by Mr. Eliot. The number of stations, sending daily telegrams, was increased from seven to fifteen; all, with one exception, *viz.*, Dacca, situated on the coasts of the Bay of Bengal; and arrangements were made for lithographing the daily reports, and printing them in the office, whereby the issue has been so much expedited, that they are now sent out about 3 P.M. for distribution to the Port authorities, the Chamber of Commerce, merchants, and newspapaper; instead of, as hitherto, in the evening, and to a much more restricted circle. Moreover, the reports are accompanied with a lithographed chart of the Bay of Bengal, which gives the information in a graphic form, easily comprehended at a glance. The small additional expense involved by these improvements is amply covered by the subscription of Rs. 2 monthly received from the non-official recipients.

GROUND TEMPERATURE.—In the report for last year, I gave an account of the results of the observations of the temperature of the ground at Alipore, at the surface,

and at depths of 1 foot and 3 feet respectively, and remarked on the fact that the temperature of the ground was found to be not less than 5° in excess of that of the air. These observations have shown that the ground acts as a reservoir of the heat received from the sun, which it stores up and slowly gives forth to the atmosphere. Subsequent observations have shown that the ground temperature is subject to slow but not inconsiderable fluctuations, which depend, evidently, much more on the rainfall, than on any variation in the radiant intensity of the luminary. The facts, above referred to, have an important bearing on agriculture, and are well worthy the attention of agri and horticulturists. They also have much meaning in connection with meteorology. They show directly and in an intense degree, the local effect of heating and cooling agencies, and it has seemed, therefore, desirable, that observations of a similar character should be undertaken in other parts of India. A set of thermometers and tubes, similar to those in use at Alipore, were furnished, in April last, to Mr. Hill for the Allahabad observatory; and observations of the local ground temperature have been recorded, four times daily, (at equal intervals of six hours,) since the 1st May 1880. These show that the temperature of the ground at Allahabad exceeds that of the superjacent atmosphere by almost the same amount as at Alipore; and since the late Mr. J. A. Broun found a similar excess in the ground at Trevendrum, it may be inferred, with much probability, that this is a law of general incidence in India.

I anticipate that similar observations will be shortly commenced at Jeypore, at the observatory founded by His Highness the Maharaja, and to which further reference will be made in a subsequent paragraph of this report.

FIRST CLASS OBSERVATORIES.—It is a matter of much regret that Calcutta and Bombay are still the only observatories of the first class, provided with instruments registering continuously and autographically. The Van Rysselberghe's meteorographs, destined for Allahabad and Lahore, which were ordered in 1876, arrived in Calcutta towards the beginning of the year under report, but neither at Allahabad nor Lahore have any arrangements been made for a permanent observatory, and at both these important cities, the temporary arrangements made in 1875 (or before) are still in operation. Nor does there seem any immediate prospect of a permanent site and building accommodation for an observatory being provided at either of these stations. At Allahabad, since the site originally assigned for the observatory in the Alfred Park has been declared unavailable, it has been proposed to attach the Meteorological Reporter's office and observatory to the Muir College, for which a new building is now in course of erection. This site would be well fitted for the purpose, had provision been made for accommodating the observatory, and were the lofty tower, which forms part of the building, rendered available for the anemometer. But no provision has been made, and according to the latest report received, it does not appear to be absolutely decided even that the observatory shall form part of the college building. This delay is very much to be regretted, not only because the prospect of establishing the proposed first class observatory is indefinitely retarded, but also because there is much fear that it will be rendered impossible to preserve that continuity in the conditions of the observations, which will allow of a comparison between the future and past work. The observatory is now and has been, for many years past, situated at the private dwelling-house of the Meteorological Reporter. The position of this house is such, that the temperature,

humidity, and perhaps other meteorological elements, may be expected to have a different normal value from those which will be recorded at the new observatory. How great this difference may be, has been conspicuously shown in the case of the removal of the Calcutta observatory from Chowringhee to Alipore. In order to ascertain this difference and so render it possible to correct the former records to the conditions of the new site, at least one year's comparative observations should be recorded simultaneously at both. But there is much probability that, before the new observatory can be ready to receive the instruments, the site of the present observatory will have to be vacated, and thus the work of many years will be rendered obsolete for future requirements.

The case of the Lahore observatory is very similar; but there are other difficulties in the way of bringing the meteorograph into use at this station. And, however desirable it may be to establish a first class observatory in the Punjab, with its characteristically continental climate, I see no prospect of doing so, with success, under present circumstances.

One of the meteorographs has been set up at the Meteorological Office in Chowringhee, and worked well during the few weeks that elapsed before I left for Simla. It is, however, an instrument of delicate adjustment, and to ensure its satisfactory working, requires the constant supervision of some person practically familiar with the management of delicate instruments and apparatus. In the absence of such supervision it could only prove a failure.

EXTENSION OF OBSERVATORIES.—In January 1880, the observatory sanctioned for Zanzibar commenced working under Dr. Peters, to whose exertions it is due; and the registers have since been communicated regularly to this office. An observatory was opened at Aden on the 15th July of the same year. Instruments have also been furnished for an observatory at Amini Divi, one of the Lakadive Islands, and an observer has been trained for the purpose at the Madras observatory. As yet, however, no registers have been received. It is now in contemplation to form observatories at Socotra and the Seychelles if found practicable, but this is at present uncertain.

In India, a new observatory was opened, in connection with the Salt Department, at Sambhar on the 1st April 1880, and two, much required to complete the system of Southern India, commenced work at Mercara and Mangalore in March 1880. An important addition to the independent observatories, which contribute registers to the office, has been made during the past year, in the resuscitation and reorganisation of a meteorological observatory at Jeypore, at the charge of His Highness the Maharaja of that State; and by the exertion of Dr. Hendley, the Civil Surgeon to the Agency for the Eastern Rajputana States. At present, (since the 1st January 1881) this observatory is working on the same system as the second class observatories of this department, and I have lately been informed that it is proposed to raise it to the position of a first class observatory, provided with autographic instruments. This will form a valuable addition to the system, Jeypore being situated on the margin of the dry tract of Western India, in a climate which is more characteristically continental than any existing observatory of that class or even than Allahabad.

The removal of the Calcutta observatory, from the Surveyor General's Office to Alipore, left us without any record of the characteristic climatic features of the city of Calcutta, as distinguished from those of the suburbs; and comparative observations,

carried on for two years simultaneously at the old and new sites, showed that there is a marked difference in the temperature and humidity of the two,—a difference which renders it desirable that an independent record should be kept of the climatic conditions of the city. I have therefore made arrangements, for recording observations of temperature and humidity at the Meteorological Office, Chowringhee, under conditions very similar to those of the old observatory at the Surveyor General's Office. These were commenced in December 1880.

CALCUTTA TIME-BALL.—The new time-ball and apparatus for the semaphore tower in Fort William was received in April 1880. A precisely similar set had been ordered from the same makers, Messrs. Varley and Co., by the Port Commissioners, for their office on the Strand, as it has been found that the ball in Fort William is invisible to ships lying in the upper part of the port. This latter set did not arrive until later in the year. As, however, it was desirable to set up the Port Commissioners' time-ball in the first instance, and to utilise it for giving the time to the shipping, during the removal of the old ball and the substitution of the new apparatus at the Fort William semaphore, the apparatus received from the Secretary of State was, with the sanction of Government, transferred to the Port Commissioners, and their own set taken over on its arrival in exchange. Some little delay was incurred, by the necessity of supplying some additions to the apparatus for connecting the ball on the roof of the Port Commissioners' Office with the trigger in the office room below. A system of levers, designed for the purpose by the Vice-Chairman, Mr. Duff Bruce, was constructed and fitted, and this having been completed in March 1881 and found to work satisfactorily, after a few preliminary experiments to make sure of the working, notifications were issued that, on and after the 1st April, time would be given to the port by the new ball, and the old ball would be disused. Steps were then taken to effect the substitution of the new ball on the Fort semaphore, and the work is now nearly completed. The ball on the Port Commissioners' Office has worked hitherto in the most satisfactory manner. As in the case of the semaphore time-ball, the charge of the communications and batteries is in the hands of the Electric Telegraph Department.

MARINE METEOROLOGY.—The remaining portion of the meteorological observations extracted from the meteorological logs in the possession of the London Meteorological Office were received during the past year. These consist of all the observations, recorded in Indian seas-north of the equator, between East Longitude 50° and East Longitude 100°, up to the end of the year 1878, and are reduced, corrected, and tabulated according to the months, and squares of 1° latitude and longitude, and arranged in 154 data books, one for each 10° square in each month. It now remains to discuss this very valuable mass of statistics, with a view to publication, and to a knowledge of the normal meteorological conditions of the seas in question. This knowledge is indispensible to a rational comprehension of the monsoons. In preparing this work for publication, I propose to follow, as nearly as possible, the methods of reduction and graphic representation adopted by the Marine Department of the London Meteorological Office, which, after long experience, have been framed under the guidance of a consultative body, which includes some of the most experienced meteorologists and physicists of England. I have accordingly applied to the Meteorological Council of the Royal Society, for full information respecting their present method of procedure, and only await the receipt of this information, to commence the work of discussion.

As already mentioned, this work will afford us a knowledge of the *normal* meteorological conditions prevailing over Indian seas, as deduced from the observations of past years. But since one of the principal objects of the department is to obtain a knowledge of the conditions under which the strength, steadiness, and wetness of the monsoons vary in different years, it becomes necessary to make arrangements for obtaining cotemporary data of the same character. A report has lately been sent up to Government, submitting some proposals with this object, and meanwhile Mr. Eliot, the Meteorological Reporter to the Government of Bengal, is taking some steps to obtain information from the shipping arriving at the Port of Calcutta, steps which may be regarded as experimental, and the results of which will serve to show in what direction and in what manner the scheme may be susceptible of development.

OBSERVATORIES.

The list of observatories in operation, during the whole or part of the year ending 31st March 1881, is the same as that given at page 5 of the Administration Report for 1879-80, with the following additions :—

Two extra Indian observatories at Zanzibar and Aden :—

One at Chowringhee, Calcutta, in connection with the Meteorological Office, for registering temperature, humidity, and rainfall only.

One private observatory at Jeypore.

The observatory at Thull on the frontier of Afghanistan was dismantled and abandoned on the withdrawal of the telegraphic establishment on the 24th February 1881.

There were, therefore, in all, 121 observatories communicating registers to the department, distributed as follow :—

INDIAN EMPIRE.

Bengal and Assam	21
North-Western Provinces and Oudh	14
Punjab	12
Central Provinces	11
Berar	5
Central India and Rajputana Agencies...	10
Bombay	14
Madras, Mysore, Coorg, and Hyderabad	16
British Burmah	8
Bay Islands	2
TOTAL ...	113

EXTRA INDIAN SETTLEMENTS AND FOREIGN STATES.

Nepal	1
Kashmir territories	2
Baloochistan	1
Persian Gulf	1
Aden	1
Zanzibar	1
Goa	1
TOTAL ...	8

Instruments were supplied to three other observatories during the year, *viz.*, to Amini Divi in the Lakadives, and to Pauri and Pithoragarh in Kumaon, at which the observations are to be recorded by volunteer observers; but registers were not received from any of these during the year under report.

The whole number of observatories actually working during the year 1880-81 was, therefore, two more than in 1879-80, as shown in the report for that year, but really only one more, since registers were contributed from Zanzibar for two-and-half months of the previous year; but not having been received at the time the report was written, the fact was not noticed in the report.

Of the whole number, two were first class observatories, with instruments registering autographically; twenty-three second class observatories, at twenty-two of which, in addition to observations at 10 h. and 16 h., hourly readings are registered on four (or in some cases three) days in each month; at all but one of these latter, synoptic observations are also registered daily at 7 h. 10 m., Washington time (18 h. 1 m., Calcutta time). The remainder, with four exceptions, are third class stations, registering two full sets of observations (and in the case of certain of the Madras stations three sets) daily. The four excepted stations—Chowringhee (Calcutta), Mangpoo, Demagiri, and Makhla—register only temperature, humidity, rainfall, and wind direction. The observations may further be classed as—

Government observatories with paid observers under the Meteorological Department	104
Observatories in Government Offices, observers not paid by the Meteorological Department	14
Private and foreign observatories	3

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character; and is immediately superintended by the Reporter to the Government of India; and the establishment is under the immediate charge of the Chief Observer, Babu Brojo Mohun Rakhit.

The work of the observatory consists of—

1st.—Continuous registration of the atmospheric pressure, temperature, moisture, (dry and wet bulb thermometers), wind direction, movement and pressure, and the rainfall, by autographic instruments.

2nd.—Periodical readings of the barometer, dry and wet bulb thermometers (including maximum and minimum), the rain-gauge and the actinometer, and estimate of cloud proportion. The temperature readings include those of the temperature of the air in shade, under a shed of the usual pattern, also in shaded cages at 4 feet and 40 feet above the ground, those of nocturnal radiation and insolation, and those of the ground at the surface and at 1 foot and 3 feet deep.

3rd.—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporters for Western India and Madras; and the comparison of all barometers with the Calcutta standard.

4th.—The determination of the mean local time by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port.

The establishment for the purposes consists of—

Babu Brojo Mohun Rakhit	...	... Chief Observer.
„ Khettra Mohun Mookerjee	...	... 1st Photo. Asst.
„ Mahendronath Bhuttacharjee	...	... 2nd ditto.
„ Mohendronath Banerjee...	...	... Observer.
„ Syam Lall Sen ...	...	... Ditto.

2 Artificers.[1]
1 Battery man.[1]
6 Servants.

The autographic instruments consist of a Kew barograph and thermograph, which register by photography, a Beckley's anemograph, an Osler's anemometer, and a Beckley's rain-gauge. During the past year, all these instruments have worked fairly well, but during the hot weather the photographic traces are such as still leave much to be desired. The introduction of an improvement suggested by Captain Westerhouse, *viz.*, the use of citric acid in the development of the traces, has so far obviated the fogging due to the high temperature, that, with very rare exceptions, the traces are measurable. But there has been a want of practical intelligence on the part of the assistants, that causes considerable inequality in the results. Recently there has been a marked improvement, due to greater care, which I hope will be maintained; but in the absence of scientific knowledge on the part of the assistants, any experimental modification of the process to meet the varying condition of the climate, is perhaps hardly to be expected. The anemographs and rain-gauge, which record mechanically, present no such difficulties, and give satisfactory results.

The following table gives a comparative view of the mean results of the autographic registers of the barograph and thermograph, and of the eye observations of the barometer and thermometers, recorded at the same hours. The standard barometer has the cistern about 1 foot higher than that of the barograph, and the standard thermometers are exposed under a shed open all round, while the bulbs of the thermograph are under a louvred pent house, against the north wall of the observatory:—

Comparative mean reduced readings of barograph and standard barometer in 1880.

1880.	Standard Barometer.					Barograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January	29·959	30·033	29·809	29·974	29·966	29·952	30·032	29·899	29·976	29·965
February	·946	·022	·889	·958	·954	·943	·022	·889	·964	·954
March	·840	29·905	·764	·850	·840	·838	29·906	·763	·852	·840
April	·757	·813	·677	·755	·751	·759	·816	·678	·760	·753
May	·672	·722	·595	·692	·670	·675	·726	·599	·698	·674
June	·520	·556	·472	·555	·526	·516	·558	·474	·554	·526
July	·558	·593	·500	·587	·560	·557	·594	·499	·588	·560
August	·608	·649	·551	·640	·612	·605	·651	·552	·642	·612
September	·709	·756	·643	·730	·710	·707	·761	·646	·735	·712
October	·880	·929	·814	·889	·878	·881	·935	·818	·895	·882
November	30·016	30·067	·955	30·025	30·016	30·017	·075	·959	30·033	30·021
December	·054	·115	·994	·067	·058	·056	·124	·969	·077	·064
Year ...	29·793	29·847	29·729	29·810	29·795	29·792	29·850	29·731	29·815	29·797

[1] Employed for the Time-ball apparatus.

Comparative mean readings of the thermograph and dry bulb thermometer in thermometer shed in 1880.

1880.	Thermometer in shade.					Thermograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January	58·0	68·9	76·8	62·3	66·5	58·9	67·5	75·4	62·9	66·2
February	63·0	72·4	79·6	67·5	70·6	63·7	71·3	78·1	67·7	70·2
March	70·6	81·6	87·6	75·0	78·7	71·5	80·8	87·2	75·9	78·8
April	77·3	87·2	91·2	79·7	83·8	78·2	87·8	91·7	80·7	84·6
May	77·2	86·9	89·5	78·9	83·1	78·1	87·5	89·7	79·9	83·8
June	80·1	85·1	84·4	81·3	82·7	80·9	85·6	85·1	81·9	83·4
July	78·9	83·7	85·0	80·2	81·9	79·6	84·5	85·7	80·9	82·7
August	79·3	83·6	84·2	80·4	81·9	79·9	84·0	84·7	80·9	82·4
September	77·8	83·1	83·4	79·6	81·0	78·4	83·3	83·8	80·0	81·4
October	76·5	82·9	83·6	78·0	80·3	77·2	82·6	83·7	78·5	80·5
November	65·9	75·5	78·7	68·4	72·1	66·9	74·7	78·2	69·1	72·2
December	55·8	68·4	74·0	59·8	64·5	57·1	66·8	73·1	60·7	64·4
Year ...	71·7	79·9	83·2	74·3	77·3	72·5	79·7	83·0	74·9	77·6

Comparative mean readings of the thermograph and wet bulb thermometer in thermometer shed in 1880.

1880.	Wet bulb in shade.					Thermograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January	56·3	62·2	63·3	59·4	60·4	56·5	61·2	62·7	59·4	60·0
February	60·9	65·2	66·3	63·7	64·0	61·1	64·0	65·7	64·0	63·7
March	68·9	73·1	73·2	71·1	71·6	69·1	73·2	73·5	71·7	71·9
April	75·1	78·2	78·1	75·7	76·8	75·6	79·3	79·5	76·1	77·6
May	75·3	78·9	78·4	75·1	76·9	75·7	79·8	79·5	75·7	77·7
June	78·8	80·7	80·3	79·2	79·7	78·4	80·9	80·5	79·0	79·7
July	77·9	79·6	79·9	78·1	78·9	78·1	80·3	80·8	78·5	79·4
August	78·2	79·9	80·1	78·4	79·2	78·4	80·4	80·7	78·9	79·6
September	76·9	78·3	78·3	77·9	77·9	76·9	78·8	79·0	78·0	78·2
October	75·6	77·7	76·9	76·4	76·7	75·8	77·9	77·4	76·6	76·9
November	64·2	67·3	67·6	66·3	66·4	64·5	67·1	68·0	66·5	66·5
December	54·3	60·1	61·1	57·4	58·2	54·9	59·6	61·2	57·7	58·4
Year ...	70·2	73·4	73·6	71·6	72·2	70·4	73·5	74·0	71·8	72·5

The above results are fairly accordant. There is a slight excess in the barograph values of the later months, the cause of which is not very obvious. The small difference

of the thermometric eye readings and the thermograph values may be attributed, with much probability, to the unavoidable difference in the exposure of the instruments.

The observations of a Stewart's actinometer have been made on all clear days, at apparent (not mean) noon, and two hours before and after; and the results, for a complete year, have been reduced and sent home to Professor G. G. Stokes, the Secretary to the Committee for Solar Physics. The results show that, the haze so prevalent in Calcutta, as at most places on the plains of India, renders the observations somewhat irregular, and that Calcutta is consequently by no means a favourable station for obtaining absolute values. The observations may nevertheless be of much value for comparative work, and they will, therefore, be continued. Moreover, it will be useful to treat the Calcutta actinometer as a standard instrument, with which to compare those to be observed at other more favourably situated stations.

The ground temperature observations have been steadily continued, the thermometers being read three times daily, at intervals of 8 hours. The thermometer at 1 foot deep, formerly observed, having been destroyed in taking it up, for the purpose of examination, as was noticed at page 23 of the Administration Report for last year, a verified standard thermometer was substituted on the 1st April 1880; being loosely inserted in a wooden tube, sunk to the proper depth, in a manner similar to that previously adopted with the thermometer at 3 feet deep. The mean temperature given by the three thermometers and that of the air are given in the following table :—

1880-81.	Surface.			1 foot deep.			3 feet deep.			Means.			
	5½-hour.	13½-hour.	21½-hour.	5½-hour.	13½-hour.	21½-hour.	5½-hour.	13½-hour.	21½-hour.	Air in shade.	Surface.	1 foot.	3 feet.
April	77·8	106·4	80·9	85·7	86·0	87·3	84·0	84·2	84·1	84·2	88·4	86·3	84·1
May	79·9	96·7	81·9	85·8	86·5	87·1	85·5	85·6	85·5	83·6	86·2	86·5	85·5
June	82·7	90·0	83·9	85·7	85·7	86·2	86·0	85·9	85·9	83·3	85·5	85·9	85·9
July	82·0	93·0	83·6	85·7	85·7	86·0	85·5	85·6	85·5	82·5	86·2	85·8	85·5
August	82·2	91·0	83·8	85·1	85·1	85·3	85·5	85·5	85·5	82·2	85·7	85 2	85·5
September	80·1	92·5	82·1	84·2	84·2	84·6	84·9	85·1	85·0	81·2	84·9	84·3	85·0
October	79·2	91·8	81·1	84·0	83·9	84·1	84·9	84·9	84·9	80·2	84·0	84·0	84·9
November	68·8	82·1	71·5	76·8	77·2	76·9	81·0	81·2	81·2	71·9	74·1	77·0	81·1
December	58·1	73·6	61·9	68·8	69·2	69·3	74·5	74·9	74·8	63·9	64·5	69·1	74·7
January	56·0	72·2	60·0	66·3	67·0	67·4	71·8	72·1	72·1	63·0	62·7	66·9	72·0
February	64·7	83·4	67·9	71·3	71·8	72·4	73·5	73·6	73·5	71·4	72·0	71·8	73·5
March	70·3	91·4	73·8	76·6	76·8	77·2	77·8	77·9	77·9	75·1	78·5	76·9	77 9
Means ...	73·5	88·7	76·0	79·7	79·9	80·3	81·2	81·4	81·3	76·9	79·4	80·0	81·3

The means for the year show the remarkable result that, not only is the temperature of the ground at 3 feet deep, 4·4° in excess of that of the air, but it is apparently 1·3° in excess of that at 1 foot deep and 1·9° in excess of that of the surface. This last result is of doubtful validity, for it is highly improbable that the arithmetical mean of

three observations gives the true diurnal mean surface temperature. But the range of temperature at 1 foot deep and that at 3 feet deep are evidently too small, to allow of any error being involved in the assumption, of such magnitude, as to give rise to the apparent difference. The explanation must remain for future determination. Another fact of interest is that, on the mean of the year, the excess of the ground temperature over that of the air was only 4·4°, whereas during the twelve months preceding it averaged 5·4°. Yet the mean temperature of the air was nearly the same in both years, *viz.*, 77·1° in 1879-80 and 76·9° in 1880-81. The probable explanation is that, during the hot year 1878-79, the ground received a charge of heat which has since been in course of dissipation; and this may partly account for the increase of temperature with increasing depth. A fuller discussion of this subject will be given in the report on the meteorology of 1880.

The number of instruments verified at the Alipore observatory, during the year ending 31st March 1881, is as follows :—

1. Barometers	42
2. Aneroids	7
3. Dry and wet bulb thermometers	68
4. Maximum thermometers for air temperatures	21
5. Minimum ditto ditto	20
6. Ditto ditto for nocturnal radiation	35
7. Solar radiation thermometers	11
8. Standard thermometer	1
9. Actinometer	1
TOTAL ...	206

The following is a summary of the instruments received and issued by the observatory :—

	Received.	Issued.
1. Barometers	38	40
2. Aneroids	2	3
3. Dry and wet bulb thermometers	11	21
4. Maximum thermometers for air temperatures ...	10	6
5. Minimum ditto ditto ...	12	17
6. Ditto ditto for nocturnal radiation ...	3	22
7. Standard thermometer	1	1
8. Solar radiation thermometers	4	18
9. Boiling point thermometers	0	0
10. Thermograph	0	1
11. Actinometers	2	0
12. Anemographs	0	2
13. Anemometers	2	19
14. Anemoscopes	1	4
15. Rain-gauge	1	1
TOTAL ...	87	155

These include the instruments issued for the equipment of new observatories as well as those furnished to replace injured and broken instruments.

The consumption of instruments at the different observatories will be shown, in a tabular form, in another section of the report.

The time signals were given up to the end of the year, with the old time-ball on the semaphore tower in Fort William. The new apparatus, invented and constructed by Messrs. Varley, which was received in the early part of the year under report, was set up on the roof of the Port Commissioners' Office in the latter part of 1880; but it became necessary to supplement the apparatus with a system of levers to establish communication between the trigger in the office room on the upper story and the time-ball, which was raised on a platform erected on the roof. This was completed only in March, and in the latter part of the month some preliminary trials were made with the new apparatus, which having proved perfectly successful, the service of the old apparatus on the semaphore tower was discontinued at the end of the year; preparatory to its being dismounted and replaced by a duplicate set of Messrs. Varley's apparatus.

The time-ball was dropped accurately on 276 days. Of the remaining days 75 were Sundays or public holidays, and on 13 the apparatus failed to work accurately, owing to interruption of the communication or other causes.[1] On one day the apparatus was under repair.

Other observatories in Bengal and Assam.—There were, during the whole or a portion of the past year, seven observatories of the second class, ten of the third class, and three of the fourth class in Bengal, including the fourth class observatory established on the 1st December 1880 in connection with the Meteorological Office in Chowringhee :—

Second Class.

Sibsagar.	Patna.	Cuttack.
Goalpara.	Hazaribagh.	Chittagong.
	Saugor Island.	

Third Class.

Darjeeling.	Gya.	Silchar.
Purneah.	Berhampore.	False Point.
Durbhanga.	Burdwan.	Jessore.
	Dacca.	

Fourth Class.

Demagiri.	Mongpoo.	Calcutta (Chowringhee).

[1] The following return shows the days on which the time signal either failed to work accurately or failed altogether during the official year 1880-81 :—

Dates of failure.	Extent of failure.
1880.	
April 2nd	Ball dropped 0·75s too late.
May 7th	Ball dropped 0·75s too late.
June 12th	Ball dropped 0·50s too late.
August 11th	Ball dropped 3·00s too late.
„ 12th	Ball dropped 0·75s too late.
„ 17th	Failed altogether.
October 1st	Ball was hoisted, but the electrical current did not release it. It was lowered by the artificers at the tower when the failure of electrical current was apparent.
„ 5th	Ball dropped 0·75s too late.
December 31st	Ball dropped 1·25s too late.
1881.	
January 7th	Ball dropped 0·75s too late.
„ 8th	Ball dropped 1·25s too late.
March 3rd	Failed altogether.
„ 16th	Failed altogether.

At stations of the second class, excepting Saugor Island, hourly observations are recorded on four days in each month, and also synoptic observations, which, up to the end of 1880, were taken at 18h. 36m. Calcutta mean time. From the 1st January 1881, at the request of the Chief Signal Officer, United States Army, who directs the working of the system, this was changed to 18h. 1m., a similar change having been introduced at all other stations that contribute registers to the Washington Signal Office. In addition to the above, full sets of observations are recorded daily at 10h. and 16h., as at stations of the third class; and Chittagong, Saugor Island, Hazaribagh, and Cuttack are furnished with self-recording anemographs; of Beckley's pattern at the two former, of Casella's at the two latter stations. Anemographs were also provided for Patna and Goalpara, but it has become necessary to move both these observatories, and they have not been set up. That of Goalpara had to be moved in consequence of the transfer of the Civil Offices to Dhubri lower down the river; and the transfer of the observatory took place at the end of the year under report. The construction of a building for the anemograph at Dhubri had received the sanction of the Government, but had not been actually put in hand, up to the close of the year. The removal of the observatory at Patna was rendered necessary, owing to building encroachments on the site of the present observatory; whereby, as reported by Mr. Eliot in his Administration Report of last year, the exposure of the instruments has been materially impaired. Mr. Eliot visited Patna in December, and inspected the proposed new site at the Temple School of Medicine, and having approved of it, made arrangements for observations being carried on for a year, simultaneously with those at the present observatory, in order to ascertain what changes will be introduced into the normal values of the meteorological elements by the removal. Meanwhile, it has been resolved to transfer the anemograph to Darjeeling, the observatory of which station is also about to be removed to an improved site. The anemograph will be more useful at the hill station, as, while there are anemographs either at work or proposed, for other stations on the Gangetic plain, there is at present none at any hill station, and a more accurate knowledge of the winds on the hills is very much required.

Of the second class observatories, Hazaribagh, Patna, Cuttack, and Chittagong have been inspected during the year, the first three by Mr. Eliot, the last by myself; and Sibsagor was inspected by the Chief Commissioner, Mr. C. Elliott, who found it in a very satisfactory condition.

The site of the Hazaribagh observatory was changed in November 1880, but only to a short distance, *viz.*, to the ground at the opposite extremity of the Central Jail, where a tower had been built for the anemograph, on the highest ground that occurs in the neighbourhood of Hazaribagh. Mr. Eliot found the observatory in thoroughly good order. The anemograph was working rather stiffly, and required cleaning and oiling, which was effected by Mr. Eliot during his visit.

The Cuttack observatory is at the telegraph office, and in not quite so open a position as that of Hazaribagh. The anemograph, on the roof of the office, was found to be in capital order. Mr. Eliot reports very favourably of the observer Mr. J. C. Smith, the Telegraph Master, who takes a very intelligent interest in his meteorological work, and is one of the best of the Bengal observers. The instruments were all thoroughly clean, and the registers very neatly kept.

The Patna (Bankipore) observatory was found to be generally in good order. The anemometer was working badly, and was insecurely fixed on a post which oscillated considerably. The proposed removal of this observatory has already been noticed.

The observatory at Chittagong was removed to a new site in March 1879; the removal being necessitated by that of the Electric Telegraph Office, to which it is attached. The new site is about a mile to the south of that formerly occupied, and is decidedly superior to it in point of exposure. The elevation is about the same. For some months before my visit, I had been struck with the apparently erratic behaviour of the Chittagong barometer, as evidenced in the daily reports; and especially by the lowness of its readings. On inspection, the explanation was obvious. With an entire disregard of the printed instructions, which, I regret to say, is far too common with observers, the barometer had been hung in so bad a light, and so high up, that accurate reading was out of the question, and the observer, Mr. Pereira, in further disregard of the printed instructions, was accustomed to set his vernier to the bottom of the meniscus, the summit of the column being invisible. As a consequence, all the barometric readings recorded since the removal of the observatory have been rejected as untrustworthy.

The barometer and thermometers were all verified, and it was found that some of the latter had changed by amounts varying from $+0.1^\circ$ to $+0.9^\circ$ owing to the slow contraction of the bulb, since they were orriginally issued, ten years ago. The barometer was unchanged, and gave the same values as when originally verified.

The anemograph was clean and in good condition, excepting that some of the working parts, which the observer did not know how to reach, were somewhat clogged with hardened oil. The instrument was dismounted and cleaned during my visit.

At observatories of the 3rd class, observations of all instruments are recorded daily at 10h. and 16h.; but neither the hourly nor synoptic readings are taken. Mr. Eliot reports that he has reason to believe, from the intercomparison of the observations furnished by them, that they are in a satisfactory state and furnish fairly accurate observations. The Berhampore, Burdwan, Dacca, and False Point observatories are the most satisfactory. "The observers at these stations are not only intelligent, but take a real and hearty interest in their work, and send in their returns carefully and neatly drawn up and with creditable punctuality." Three of these observatories were inspected during the year, *viz.*, False Point, Berhampore, and Darjeeling.

The present observatory, at False Point, is situated on an open site, near the Telegraph Office at Jamboo, opposite the harbour, and several miles to the north of the old observatory at False Point Light-House, at which the instruments were registered up to October 1877. As a new telegraph office is being erected at Hookeytollah [1] on the the newly formed spit that encloses the harbour, it was anticipated that it would again be necessary to remove the observatory; a step which would almost certainly introduce a further change in the normal values of the registers, and therefore much to be regretted. It appears from a comparison of the temperatures recorded at the present and former observatories, that the mean temperature, now registered, is some degrees lower than that of the Light-House site, so that the present results are not comparable with those of former years; and another change of site would almost certainly be followed by a similar

[1] So named in honour of the former Superintending Engineer of the Orissa Irrigation Works, Mr. Walker. Etymological purism has since converted the name into Hukitollah.

change. It is therefore satisfactory to learn that the present office will be retained, and the threatened transfer of the observatory will be averted. Mr. Eliot found the instruments in good order, but the thermometer shed was in want of repairs, the execution of which had been deferred in view of the anticipated transfer. These have now been effected, and the observatory is in good working condition and in the hands of a trustworthy and intelligent observer, Mr. G. S. Adshead.

The Berhampore observatory was last visited by myself in 1876, and its site was changed, in September of that year, to another part of the station. It is now placed on an open maidan, a short distance from the river, and from the Civil Surgeon's Office. The shed is reported to be too small for the proper protection of the thermometers, and Mr. Eliot recommends its reconstruction, more in accordance with the dimensions laid down in the *Vade Mecum*. The anemometer was badly fixed, and Mr. Eliot considers that the wind velocities registered during the past two years are probably too low. But he reports that the observer, Babu Mohendra Nath Roy, who has held the post since the observatory was established in 1867, is intelligent and accurate; and with the above exception, the instruments were in good order.

The Darjeeling observatory was visited in December, with a view to placing it on a more satisfactory footing. The present observatory is situated at the Telegraph Office, on the side of the hill below the Mall, in which position it has been since the 1st April 1870. Owing, however, to the erection of buildings immediately contiguous to the Electric Telegraph Office, the site has been so much encroached on, and the exposure of the instruments so much impaired, that, however such a step is to be regretted, it has become absolutely necessary to make arrangements for the removal of the instruments. Mr. Eliot has now arranged for the establishment of the observatory at St. Paul's school, on the summit of the Jellapahar ridge, at a house formerly occupied by Mr. Brian Hodgson, and well known as the site at which Dr. (now Sir) J. Hooker observed in 1848. It is undoubtedly one of the best positions for the purpose afforded by Darjeeling, and presents, among other advantages, that of being an admirable site for an anemometer, and it has, therefore, been resolved to transfer to Darjeeling the Casella's anemograph, which was originally destined for Patna. It is proposed to carry on the observations simultaneously at the new and old sites for one year, in order to ascertain the difference of mean values which will be introduced by the transfer.

From the above, it will be seen that the cases of the actual or prospective removal of observatories, have been unusually numerous at the Bengal stations; and to those already mentioned must be added that of Silchar which was moved in June 1880. This last, which was effected by the Superintendent, without previous communication with the Meteorological Reporter, was made the subject of a correspondence with the Government of India; in consequence of which, orders were issued, with the object of preventing any such unauthorised removal for the future; and it was directed that, in the event of such removal being necessitated by the requirements of other departments, the department requiring the removal, should bear the cost of a year's comparative observations at the new (or old) site, in anticipation of the transfer.

The new observatory of the 4th class was established in connection with the Meteorological Office, Chowringhee, on the 1st December 1880, in order to resume the register of the temperature of the town of Calcutta, which was dropped when the observatory

was transferred from Chowringhee to Alipore. It aims only at registering the temperature and humidity, the two meteorological elements which are of most importance in sanitary enquiries.

Mr. Eliot's Report on the Administration of his Department is reproduced in Appendix A. It takes cognisance also of the Akyab observatory, which will be noticed under the observatories of Burmah, and of some other subjects which will be duly referred to in another part of this report.

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH.—In the North-Western Provinces, there were, as in preceding years, four observatories of the second class and ten of the third class, which are as follow :—

Second Class.

Allahabad.	Lucknow.
Agra.	Roorkee.

Third Class.

Chakrata.	Bareilly.
Ranikhet.	Meerut.
Mussooree (St. Fidelis).	Gorakhpur.
Mussooree (Surveyor General's Office).	Benares.
Dehra.	Jhansi.

The observatories of the second class contribute registers of the same character as stations of the same class in Bengal; two of them, Roorkee and Lucknow, being provided with anemographs of Beckley's pattern. Allahabad has long been destined as the site of a first class observatory, to be fitted with one of the Van Rysselberghe's meteorographs, which were received last year, as noticed in the introductory portion of this report. But until a proper observatory building is provided, it is useless to set this up; and meanwhile, the observations are made on the system of a second class observatory, at the house of the Meteorological Reporter. The Allahabad observatory differs from other observatories of the class, in furnishing observations daily at 10 P.M. and 4 A.M. in addition to those at 10 A.M. and 4 P.M.; and at the beginning of May 1880, observations on the temperature of the ground were commenced, on a system similar to that practised at the Alipore observatory. The observatory has also been furnished with a King's barograph, a set of twelve of Negretti and Zambras' turn-over thermometers, and a nephescope similar to that at Alipore. The first of these instruments is reported to work satisfactorily, but the thermometric apparatus is very irregular in action, owing to inherent mechanical imperfections, and it has never been brought into practical use.

Mr. Hill gives the results of the observations of ground temperature in an appendix to his report (Appendix B). It will be seen that, like the corresponding Calcutta observations, they show that the temperature of the ground exceeds that of the air, and by about the same amount; and moreover, that at 3 feet deep, the temperature is higher than at 1 foot deep.

Of the remaining second class observatories, Agra was visited by Mr. Hill in December, and Lucknow in June. The latter was also visited by myself in November.

The instruments at both were verified and found to be satisfactory, and they were clean and in good order. One result of Mr. Hill's inspection was, however, but little expected. Among the errors of practice, which are most emphatically condemned in the

Book of Instructions, with which all observatories are furnished, is that of registering the observations according to railway or Madras time. It is a practice which has sprung up from apathy and ignorance, but is one which, precisely on that account, is most difficult to eradicate. But repeated and emphatic injunctions having been issued on the subject, it was with some surprise that Mr. Hill found that, both at Agra and Lucknow, railway time was still adhered to in the work of the observatory. A more serious case of a similar character will presently be noticed at Lahore and another at Quetta. They illustrate and confirm the remark made in a previous report, and also by Mr. Eliot in his report (Appendix A), that the class of men employed as observers do not habitually refer to their books as a guide to proper methods of observation, and that to enforce the observance of the rules, frequent inspection is indispensible.

The anemograph set up at Lucknow on the roof of the museum building has been found from the first to show a movement of the wind very much lower than a small anemometer on another part of the same building, and it was with a view to ascertain the cause of this that I visited Lucknow in November. On inspecting the position of the instrument, the explanation was obvious. The anemometer is set up on the flat terraced roof about 100 feet long and 60 feet broad, surrounded by a balastrade 3 feet high. As the cups of the instrument are only 6 feet above the roof, the wind, which is generally light, is impeded by the friction of this extensive surface, and by the balastrade, and thus its motion on reaching the anemometer is reduced to, probably, less than half that which it has in free space, at the same elevation above the ground. Arrangements have now been sanctioned by the Government of the North-Western Provinces, to have the instrument removed to an independent tower at some distance from the main building.

Of the ten observatories of the third class, four are either independent of the department or dependent on it only for the instruments. Those at Dehra and at the Surveyor General's Office, Mussooree, are kept up by the Survey Department, and communicate their registers to the office of the Meteorological Reporter for the North-Western Provinces and Oudh. That at St. Fidelis's School, Mussooree, is a voluntary observatory, for which we are indebted to the Principal, Father Genesius, S.J., the instruments being supplied by the Meteorological Department. The elevation of this observatory has been recently determined by Mr. Hill, by levelling to a neighbouring bench-mark of the Great Trigonometrical Survey. The registers, taken in conjunction with those of Great Trigonometrical Survey Office, 1,024 feet higher, and those of Dehra, only 7 miles distant and 3,625 feet lower, promise to be most valuable, as furnishing materials for an enquiry into the variations in the temperature and humidity of the air in a vertical direction. I am indebted to Mr. J. B. N. Henessey, M.A., F.R.S., of the Great Trigonometrical Survey, for having, on several occasions, visited the St. Fidelis's observatory, for the purpose of supervising the proper setting up of the instruments and giving instructions in their use, &c.

Of the remaining six observatories of the third class in the North-Western Provinces, five, namely, Bareilly, Ranikhet, Jhansi, Benares, and Gorakhpur, have been inspected by Mr. Hill during the year. The barometers and thermometers were all verified, and, with one exception, found to be satisfactory; the errors determined, differing by very small amounts from those originally assigned to the instruments. In the exceptional case, that of the Gorakhpur barometer, the instrument was found to have a large error, the

existence of which has been long suspected, owing to the apparent persistent lowness of the readings. There can be little doubt that it arose from leakage having taken place in transit to the station, and the amount can now be applied as a correction to all the past readings recorded with this barometer.

The elevation of the Jhansi barometer, about which some doubts had arisen, has been re-determined, and the assigned value found to be 4·4 feet in error.

Mr. Hill reports that the observations generally have been taken, he believes, with great care, the only partial exception being in the case of Gorakhpur, where there was some manifestation of neglect. Mr. Hill found that the erroneous practice, already noticed in the case of Agra and Lucknow, *viz.*, that of observing Madras instead of local time, was also in vogue at other stations on the railway line. This has been corrected since the 1st January 1881.

Mr. Hill's report is given, nearly in full, in Appendix B.

OBSERVATORIES IN THE PUNJAB.—Throughout the greater part of the year under report, there were twelve observatories in the Punjab, as in the preceding year; but on the 24th February 1881, the observatory at Thull was closed, on the suppression of the telegraph office, and the withdrawal of the force which had occupied this frontier station, during the military operations in Afghanistan. The remaining stations are under the direction of the Meteorological Reporter to the Punjab Government, whose Administration Report will be found in Appendix C, together with a list of the superintendents and observers at the several stations. The following are the stations which contributed registers in 1880-81 :—

Second Class.

Lahore.

Third Class.

Mooltan.	Rawalpindi.	Simla.
Dera Ismail Khan.	Sialkot.	Delhi.
Thull.	Murree.	Sirsa.
Peshawar.	Ludhiana.	

The Simla observatory was placed on the same footing as other observatories of the third class, in respect of the payment of the observer, the continuity of the observations, and its control by the Meteorological Department, on the 1st April 1880. Previously to that date, it was an independent observatory, attached to the Quarter Master General's Office, and the observations were interrupted on Sundays and holidays. I do not, however, think that for one or two years past they have been less trustworthy than those of other third class stations, as the observatory had been furnished with verified instruments from Calcutta, and the former observer, Sergeant King, was a careful and trustworthy man.

Lahore still remains on the footing of a second class observatory, working on the same system as that of Allahabad. The position of the observatory is faulty in many respects, more especially as regards the wind observations; and it is much to be desired that the proposed new site at the Medical School, provided it be suitable, shall be rendered available as speedily as possible. Whether, however, it be advisable to furnish it with the Van Rysselberghe's meteorograph, which has been received for the purpose from home, will be a question for future consideration. Unless there is some one on the

spot who has a good practical acquaintance with the management of delicate mechanism and electric batteries, this beatiful instrument would be of little service.

Dr. Lawrie, in his report, mentions a very serious piece of negligence on the part of the chief observer, in whom, apparently, for some years past, a somewhat excessive amount of confidence has been placed. Up to 1875, it had been the practice at Lahore, as well as at many other observatories, to take the observations according to railway time. In consequence of my visit to Lahore in that year, it was directed that local time should be adopted, and I was assured that this had been done. Moreover, the injunction to observe local time is very emphatically laid down in the Book of Instructions, with which every observatory is provided. In the latter part of 1880, Mr. Hill found, on comparing the hourly observations of Lahore with those of other stations, that the principal phases of the diurnal variation of pressure appeared to take place so much earlier at Lahore than at other stations, as to indicate that the hourly observations were made according to railway time. On this being reported to the Meteorological Reporter for the Punjab, an investigation was made, and it was found that, in complete disregard of the instructions above referred to, railway or Madras time was that habitually observed. Some time afterwards, it was stated by the chief observer, apparently as an afterthought, that although the clock was kept regulated to railway time, he had always made the proper allowance for local time in taking the observations. In the face of the evidence of the registers themselves, as brought to my notice by Mr. Hill, I am unable to accept the observer's assurance. And the final result is, that doubt is thrown on the reliance to be placed on the chief observer's statement, and on the value of the hourly observations from 1875 to the beginning of the present year.

It is probable, as Dr. Lawrie points out, that there has been much laxity in point of punctuality at other Punjab stations, both in the above respect and also from the want of observatory clocks. These have now been supplied.

Previous to Dr. Lawrie's appointment, the inspection of the stations in the Punjab had been entrusted mainly, if not entirely, to the chief observer above mentioned, excepting that I visited certain of them in 1875 and 1876, and two were inspected by Mr. Eliot in 1878. It is, therefore, hardly a matter for surprise, that the work, at some of them, had become somewhat lax; and it is satisfactory to know that arrangements have now been made, for the annual inspection of all observatories by the Meteorological Reporter.

During the year, Mooltan, Rawalpindi, Murree, Sialkot, Ludhiana, and Simla were visited by this officer. He reports that, as a rule, the instruments were found to be in good order: but at Mooltan and Ludhiana, the barometer was improperly hung, and the instruments bore evidence of having been hurriedly cleaned up in anticipation of his visit. At Rawalpindi, the observer did not understand the working of the instruments, and had sent no telegraphic reports for a month previous to the inspection. The observatories were all found to be in good repair.

OBSERVATORIES IN THE CENTRAL PROVINCES.—There are eleven in number, as in the previous years, *viz.*, three stations of the second class and eight of the third class, as follow:—

Second Class.

Nagpur. Jubbulpore. Pachmarhi.

Third Class.

Saugor.	Chanda.
Hoshangabad.	Sironcha.
Seoni.	Raipur.
Khandwa.	Sambalpur.

The names of the superintendents and observers are given in Appendix D.

At Jubbulpore, arrangements were made for setting up the anemograph on the tower of the Municipal Hospital; but, owing to the insufficiency of the chains provided for the instrument and the consequent necessity of procuring a further supply, some delay was incurred before it could be brought into working order.

Most of the observatories having been visited by myself in the beginning of 1880, no further inspection has been made during the year under report. The work as judged by the registers, appears to have been satisfactory, with the single exception of the Saugor observatory, where the genuineness of the barometric observations has been, for many months, open to grave doubt.

OBSERVATORIES IN BERAR.—There are five of these, as in the previous year, one, *viz.*, Makhla, being established in connection with the Forest Department, and working as a fourth class observatory. It contributes its registers to the Meteorological Office in Calcutta. The remainder are under the direction of the Meteorological Reporter for Western India, in conjunction with the Sanitary Commissioner for Berar. They are—

Third Class.

Akola.	Chikalda.
Buldana.	Amraoti.

Fourth Class.

Makhla.

The names of the superintendents at the four departmental observatories are given in the table appended to Mr. Chambers' report (Appendix E III).

None of these observatories have been inspected during the year. As judged by the registers, the work appears to have been satisfactory.

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—Of these there are now ten, an important addition having been made to those enumerated in last year's report, by the establishment of an observatory at Jeypore, at the cost of the Maharaja's Government, and by the exertions of the Agency Surgeon Dr. T. H. Hendley. This observatory, which began to contribute registers on the 1st January 1881, is now working on the same system as the Allahabad observatory; and it is in contemplation, as soon as the requisite instruments can be procured, to raise it to the position of a first class observatory with autographic instruments. Even in its present condition it is a very valuable addition to the system. The following is a list of the observatories in the Central India and Rajputana States:—

Second Class.

Jeypore.

Third Class.

Sutna.	Indore.	Ajmere.
Nowgong.	Mount Abu.	Sambhar.
Neemuch.	Pachbudra.	Bickaneer.

Nowgong and Sambhar have voluntary observers, the instruments being supplied by this department; the observations at the former station are recorded at the Rajcoomar College under the superintendence of the Principal; and those at the latter, by a clerk of the Salt Agency, the observatory having been established by the kindly volunteered assistance of the Salt Commissioner, Mr. Halsey. Both these observatories, as well as those of Sutna, Ajmere, Sambhar, and Jeypore, now communicate their registers to Mr. Hill, the Meteorological Reporter for the North-Western Provinces and Oudh. Pachbudra sends its registers to my own office, and the remaining stations are under the Meteorological Reporter for Western India. Lists of the superintendents and observers are given in the reports of the above officers (Appendices *B* and *E*).

The observatory at Mount Abu was inspected by Mr. Chambers; those of Ajmere Sambhar, Jeypore, Nowgong, and Sutna, by Mr. Hill during the past year.

Mr. Chambers reports that, at Mount Abu, all was in good condition, except the nocturnal radiation thermometer, which had been broken.

At the stations visited by Mr. Hill, the instruments were found to be clean and in good order, and, with the exception of the barometers at Ajmere and Sutna, the verification of the instruments gave results equally satisfactory with those obtained at stations in the North-Western Provinces. The barometers at Ajmere and Sutna were found to have a little air in the tubes, and these have since been replaced by other instruments. The readings of the Nowgong barometer having, for a long time past, given values apparently inconsistent with those of Jhansi, but the instrument having been found in good order, Mr. Hill made arrangements for the redetermination of the elevation. This has now been effected with the result that the original determination was 12 65 in excess of the truth.

Sutna has been furnished with a Casella's anemograph. The instrument was originally intended for the second class observatory at Agra, and was sent to that station, but as there was no suitable place for setting it up, it was transferred to Sutna, the position of which is such as will render an anemographic record of the winds particularly valuable.

The Bickaneer observatory was in abeyance during one month and eight days, owing to the departure of the observer. The observations were discontinued on the 4th February 1881, but were resumed on the 13th March 1881, and have since been recorded regularly.

OBSERVATORIES IN THE BOMBAY PRESIDENCY.—There were fourteen observatories in the Bombay Presidency during the past year, as during the latter part of 1879-80; one of which, Colaba, is independent of the department, and one, Karwar, is a voluntary observatory, only the instruments being furnished by the department. These are—

First Class.

Colaba observatory (Bombay).

Second Class.

Belgaum.	Deesa.
Poona.	Kurrachee.

Third Class.

Jacobabad.	Rajkot.	Rátnagiri.
Hyderabad.	Surat.	Karwar.
Bhuj.	Sholapur.	Malegaon.

Mr. Chambers reports that, with the exception of the barometric observations at Sholapur, during the latter half of the month of October, and erroneous readings of the barometer and anemometer during the months of August and September at Malegaon, all the meteorological registers for the year 1880 have a high character for accuracy. I find, however, inconsistencies in the sun thermometer readings at Sholapore and Rajkot, which, in my opinion, have not been satisfactorily explained; they do not point to irregularities of observation, but to some constant condition, the presence of which renders the observations not comparable with those previously recorded at the same station.

The neglect of the observer at Jacobabad, to which Mr. Chambers draws attention in his report (Appendix E I), is, I regret to say, of too frequent occurrence. There can be little doubt that the majority of the observers do not habitually resort to their books for information how to perform their duties, and printed instructions, however clear and concise, are not observed, unless enforced by personal instruction and supervision.

Owing to the causes specified by Mr. Chambers in his report, the Hyderabad observatory furnished no registers from the 15th August 1880 to the 2nd May 1881.

Two of the second class and five of the third class observatories were inspected, during the year, by Mr. Chambers. The detailed results are given in his report (Appendix E). With the exception of the anemograph at Poona, and the radiation thermometers at Jacobabad, all the instruments were found to be in good order, and on re-verification gave satisfactory results.

A tower for the anemograph has been constructed at Belgaum, and the instrument set up and brought into operation.

The names of the superintendents and observers are given in Mr. Chambers' report. Mr. Chambers remarks on the inconveniences and loss of observations, (owing to the inexperience and inaccuracy of new observers,) which arise from frequent changes in the observing staff, and the impossibility of putting each new incumbent through a proper course of training, before the work is committed to him. These inconveniences are doubtless very great, and are experienced more or less in all parts of India, excepting in Madras, where the observers are more highly paid, and have, as a rule, no other duties to perform. In the case of Bombay these inconveniences were exaggerated during the past year, as Mr. Chambers points out, by the demand for medical subordinates for service on the frontier, and they will probably be less in future. But to a considerable extent they are unavoidable, and the only palliative that presents itself, (apart from an entire remodelling of the system, on a much more expensive scale,) is that which I have lately proposed to Government, *viz.*, the appointment of a travelling instructor, who may be sent as occasion demands to coach up new men in their work.

OBSERVATORIES IN MADRAS, MYSORE, AND HYDERABAD.—During 1880-81, there were sixteen observatories in these provinces, as in the preceding year, of which one, Ootacamund, is voluntary, and one, Vizagapatam, a private observatory, established by A. V. Nursingrow; to whom I am indebted for the regular communication of

his registers, in a form similar to those formerly adopted at all second class stations, and also for daily telegrams of the observations. The remaining stations all work as third class observatories, except that, at the majority, an additional set of observations is recorded at 10 P.M. The following is a list of the stations :—

Second Class (Private).

Vizagapatam.

Third Class.

Madras.	Salem	Bangalore.
Madura.	Trichinopoly.	Bellary.
Coimbatore.	Negapatam.	Secunderabad.
Wellington.	Cochin.	Masulipatam.
Ootacamund.	Mangalore.	Mercara.

No change, that I am aware of, has been made in the work of the stations, and the two proposed second class observatories, Bellary and Trichinopoly, remain, as such, in abeyance; Vizagapatam, Ootacamund, Mercara, and Mangalore communicate their registers direct to this office; the remainder to the Meteorological Reporter to the Government of Madras.

Owing to circumstances which have never been explained, the Wellington observatory was allowed to remain in abeyance, (at least no registers were furnished to this office,) for two years, *viz.*, from August 1878 to July 1880, inclusive. In some cases, observatories have remained for many months unprovided with necessary instruments, owing to the superintendents being unable to obtain them from Madras. These have been supplied from the Calcutta office, in two cases, during the past year.

As usual, no report has been received of the working of the observatories in Madras, but I am happy to be able to report a considerable improvement in the regularity with which the registers have been communicated to my office; and although the report for 1879, which is now printed and nearly ready for issue, has a few hiatus of the Madras results in the sheets first printed, the deficient data have been received in time for insertion in a supplement.

A few months before the death of the late Governor of Madras, a Committee was appointed to consider the arrangements for the future administration of the meteorological system, with a view to the removal of the causes of complaint which have the subject of frequent correspondence and representation in this and previous Administration Reports. Of the results of this Committee I have as yet no information.[1]

OBSERVATORIES IN BRITISH BURMAH.—Of the eight observatories in British Burmah, one, Akyab, has always been under the direction of the Meteorological Reporter to the Government of Bengal, and is enumerated with the Bengal stations in his report. Another, Diamond Island, was established for the especial purpose of storm warnings, and sends a daily telegram to the Bengal Office and also to Simla during the season; but the registers, as well as those of the remaining Burmese stations, are dealt with in my own office. The remaining stations are under the immediate direction of the Sanitary Commissioner of British Burmah. The following is a list of the stations :—

Second Class.

Rangoon.

[1] Since the above was written, I have received information that Miss Pogson has been appointed Meteorological Superintendent.

Third Class.

Bassein.	Thyetmio.
Diamond Island.	Tounghoo.
Akyab.	Moulmein.
Mergui.	

A list of the superintendents and observers at the six stations under the Sanitary Commissioner is given in Appendix F; that of the observer at Akyab in Mr. Eliot's report.

During the past year, all the above stations, except Tounghoo and Diamond Island, were visited and inspected by myself, and all the barometers and thermometers verified. With the exception of Akyab and Moulmein, none of the observatories had been inspected before, and the result showed that some of them stood much in need of it.

At Akyab, all the instruments were found to be in good condition, but some of the thermometers, which had been in use continuously for nine years, had undergone a change of not less than 1°. At this observatory, anything was satisfactory, the observer, who is also the Electric Telegraph Master, having had long experience in the work at Chittagong.

At Bassein, the next station visited, the instruments were also in good condition, one or two little points of erroneous practice required correction, but the observatory was evidently carefully supervised, and the arrangements generally were satisfactory. One important result of my visit was the detection of a serious error in the assigned elevation of the barometer, the height above the ground level having apparently been reported as the elevation above sea-level. This error, together with an error of sensible amount, which I discovered on comparing the barometer with portable standards, accounted for the abnormally low readings of the Bassein barometer (when reduced to sea-level) which I had long noticed, and afforded the means of correction.

At Rangoon, a second class observatory, the state of some of the instruments was less satisfactory. The anemograph (Beckley's) seemed to work satisfactorily, and the recording apparatus was clean and well cared for; but the direction gearing had been set one point in error, and the vanes and attached gearing, on the roof, were in such a position, that it was impracticable to dismount the working parts for cleaning. This has, I believe, been since remedied, by the construction of a platform with a railing, around the base of the instrument. The cistern of the barometer much required cleaning, and when cleaned and verified, the instrument was found to have a somewhat larger error than when last tested. For this no blame whatever can be attributed to the observer, but the state of the thermometers was not creditable to him, and the less excusable, that it arose from a disregard of the specific instructions furnished for his guidance.

The observatory at Thyetmio, which had not been inspected previously, was the least satisfactory in the province, as far as regards the due observance of the instructions; the barometer was hung too high for the observer, and I found, on testing his practice, that he habitually omitted the adjustment of the cistern level. Well water instead of rain water was used for his hygrometer, with the usual result of incrustation; and in the description of the weather, he used a stereotyped formula equally in the rainy and dry seasons, however untrue and inapplicable. Moreover, the wind vane was more than one point out of position. On dismounting the barometer, for the purpose of cleaning it, the glass of the cistern broke across, rendering the instrument useless. A portable baro-

meter, which I carried with me, was left therefore for temporary use, until a standard could be sent from Calcutta.

The Moulmein observatory had been visited in 1875, but a new hospital building having since been erected, the instruments had been removed to it subsequently to my former visit. The instruments were found to be in good order, except that the graduation on the thermometers had become somewhat obliterated, and the tubes of the dry and wet bulbs were somewhat loosely attached to their scales. The graduation was restored with printer's ink, and the hygrometer has since been replaced by a better instrument. The barometer and thermometers were verified and found to have the same scale values or nearly so as when originally tested. The wind vane was found to be nearly one point in error. The work of this observatory was generally satisfactory.

The last station visited was Mergui, the observatory of which had not been inspected previously. The barometer is suspended in a room in the hospital at something more than a furlong distant from the thermometer shed, wind vane, &c., an arrangement which is objectionable; but the exposure of the instruments is on the whole excellent. The barometer was also in a bad light; the cistern obscured by the formation of oxide, and on testing it I found that a little air had penetrated to the Torricillian vacuum, causing an appreciable increase of the original error. The thermometers were found to be practically unaltered. With the exception of the nocturnal radiation thermometer, which had a small drop of the spirit lodged in the upper end of the tube, all the thermometers were in good order. The wind vane was rather more than one point in error, and the anemometer had not been oiled, the observer not knowing how to open the dial box of the instrument. The observance of time was somewhat uncertain, as the station depended apparently on the fortnightly steamer for the regulation of the local clocks. The means of obtaining true local time by means of a sundial have since been supplied.

OBSERVATORIES AT THE BAY ISLANDS.—As far as can be judged from the registers, the two observatories in the Andaman and Nicobar Islands have been carried on in a satisfactory manner. They are—

Third Class.

Port Blair. Nancowry.

The list of superintendents and observers given in Appendix G shows that, at Nancowry, there have been many changes of the observing staff, changes which are much to be deprecated, but, under the circumstances of the station, probably unavoidable.

EXTRA INDIAN OBSERVATORIES.—There have been some important additions to the list given in last year's report, including one observatory which was established at the beginning of 1880, but from which the registers had not been received at the time of writing the report. Those which have contributed registers during 1880-81 are as follow :—

Second Class.

Leh. Aden.

Third Class.

Zanzibar. Gilgit.
Bushire. Katmandu.
Quetta.

and one foreign observatory in the peninsula, *viz.*, Goa, the Director of which, Señor Antonio Martins, communicates monthly abstracts of his registers to this department, and also a daily weather telegram.

The Gilgit observatory has now been in operation for upwards of two years, with the interruption of one month, when the garrison was attacked and obliged to take refuge in the fort. It is much to be regretted that, owing to the withdrawal of the Agency staff, this observatory has been recently suppressed, thus depriving us of a station, which, in the course of a year or two, would have furnished information on the non-periodic variations of the meteorology of this remote frontier region, which would have been of high value in enquiries into the influence of the mountain region on the meteorology of India.

The Leh observatory is working in the same satisfactory manner as heretofore, under the superintendence of Mr. Ney Elias, the British Joint Commissioner. The names of the observers are given in the list appended to Dr. Lawrie's report, (Appendix C) and the registers are transmitted to the Punjab office for correction and reduction.

The Quetta observatory has in general sent in satisfactory registers, but a report lately received from the Superintendent represents that there has been much difficulty in obtaining work of a satisfactory character, owing to the frequent changes in the observing staff, and some of the recent registers have had to be rejected. Here, as at so many other stations, I have had to complain of the habitual neglect of the distinct and emphatic instructions furnished to the observers in the little book drawn up for their guidance. It was recently brought casually to my notice, in a correspondence with an officer not belonging to the department, that the practice at Quetta is to take the observations according to telegraph time, that is to say, Madras time, which differs from local Quetta time by nearly an hour. As this practice is distinctly and repeatedly condemned in the official instructions above referred to, it affords a fair illustration of the habitual neglect of the local observer.

The Zanzibar observatory was established by the personal exertions of Dr. C. T. Peters. It was furnished with verified instruments by Mr. Chambers, and commenced working in January 1880 on the voluntary system; but as some additional assistance was required, in order to ensure the continuity of the work, and its character has been such as to render it desirable to establish the observatory on a permanent footing, the observer's allowance on the usual scale has lately been sanctioned by Government.

The Aden observatory was established, with a view to obtaining information of the meteorological condition of the coasts bordering on the more distant parts of the monsoon region, and, as a consequence of some remarks in the Administration Report of Mr. Eliot when officiating for me in 1878. The observatory has been constructed not far from Steamer Point, under the immediate superintendence of the Assistant Political Agent, and began working as a second class observatory on the 15th July 1880. It was visited in October by Mr. Eliot, during the brief stay of the Mail Steamer, by which he was returning from England, and the arrangements were found to be very satisfactory.

The Bushire observatory has continued to work excellently under the supervision of Colonel Ross, Her Majesty's Resident on the Persian Gulf, by whom it was originally established.—

RAINGAUGE STATION.—The stations which record rainfall only, communicate their registers to the Meteorological Reporters of Bengal, the North-Western Provinces, and

Madras, and the returns are published by them weekly or monthly in the local gazettes. In other provinces, they are either under the Revenue Boards or the Sanitary Commissioners, and the returns are in most cases published in a similiar manner. From the whole, a selection has been made; chiefly those of the sudder stations, or the seats of Political Agencies; and these, with the addition of some contributed by the Resident of Hyderabad, and by private observers, and amounting to 242 in all (exclusive of the regular observatories), are given in the annual report, in conjunction with those furnished by the observatories.

During the past year, several additions are made to the list of the reporting stations, with a view to the representation of certain portions of India, from which, returns of the rainfall have been hitherto very deficient or altogether wanting; but the results of these do not appear in the tables for 1880.

INSTRUMENTS.

The following is a return of the instruments in store at the beginning of the year, and those received and issued by the Calcutta Meteorological Office, which is the general depôt for all India :—

INSTRUMENTS.	In store on 1st April 1880.	Received. 1880-81.	Issued. 1880-81.
Von Rysselberghe's Meteorographs	...	2	...
Barometers, Observatory, Fortin's	4	3	3
„ „ K. P.	5	...	3
„ Mountain, portable tripod (Adie)	28	10	19
„ Marine, K. P.	14	...	...
„ „ Fitzroy	7	...	...
„ Adie's large standard	6	...	...
„ Newman's „ „	1	1	...
„ „ small „	4	2	1
„ Negretti and Zambra's (*various*)	17	...	1
Aneroids	19	...	...
Thermometers, standards with scales	23	...	3
„ „ without „	1	...	...
„ for Hygrometers	123	8	19
„ Maximum for shade	142	9	9
„ Minimum „ „	95	13	26
„ „ radiation	32	2	25
„ Solar *in vacuo*	53	4	22
Ponilet's Pyrheliometer	1	...	...
Stewarts' Actinometer	1	1	...
Hodgkinson's „	2	...	...
Herschell's „	1	...	..
Regnault's Hygrometers	3	1	...

Instruments.	In store on 1st April 1880.	Received, 1880-81.	Issued, 1880-81.
Daniell's Hygrometers	10	...	...
Halleur's „	5	...	...
Boiling point Thermometers	6	...	...
Spectrescope	2	...	...
Beckley's Anemographs	1	...	1
Casella's „	2	...	2
Wind Vanes	28	1	8
Anemometers	33	5	16
Raingauges	4	23	21
Measure glasses for Raingauges	11	5	9
Reading lenses	3	7	4
Clocks	...	10	10
Lanterns	...	2	2
Sun Thermometer stands	12	25	2
Radiation pads	2	31	20
Thermometer Cages	5	6	6
Magnetic Compasses	...	7	7
Prismatic „	...	1	...
Spirit Level	...	1	1

The following table, in which is incorporated that given in Mr. Chambers' report, shows the instruments that have been issued to each observatory during the year. It is not a complete list, as some instruments may have been issued by the Local Reporters for the North-Western Provinces, the Punjab, and Madras, which do not appear in it. Except, however, in the case of the last mentioned officer, they must be very few. In the next year's report, an endeavour will be made to render the list perfect:—

Return of the instruments issued to Meteorological Observatories in 1880-81.

	Station.	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer.	Radiation thermometer. Grass.	Anemometer.	Wind vane.	Raingauge.	Measure glass for the Raingauge.	Standard thermometers.	Lens.	Lantern.	Remarks.
Bengal and Assam.	Purneah ...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	
	Burdwan ...	...	1	1	...	...	...	...	1	...	...	...	...	...	...	...	
	Patna ...	...	1	...	1	...	...	...	1	1	...	...	...	...	...	...	
	Patna (new station)	1	1	1	1	1	1	1	...	1	1	1	1	...	...	...	Original furniture.
	Cuttack ...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	False Point ...	...	...	...	...	1	1	..	1	...	...	...	...	...	...	...	

Return of the instruments issued to Meteorological Observatories in 1880-81.

	Station.	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer.	Windvane.	Raingauge.	Measure glass for the raingauge.	Standard thermometers.	Lens.	Lantern.	Remarks.
Bengal and Assam.—*contd.*	Chittagong ...	...	...	...	...	1	...	1	...	...	...	....	...	...	...	...	
	Berhampore ...	...	...	...	...	..	2	2*	...	...	...	...	...	...	...	...	* One broken in transit.
	Calcutta (Meteorological Office) ...	...	1	1	1	1	1	...	..	...	...	...	...	...	...	...	Original furniture.
	Calcutta (Alipore)	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	
	Sibsagar ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Goalpara ...	...	1	1	...	...	...	1	...	...	...	...	...	...	...	...	
N.-W. Provinces.	Mussooree ...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	Ranikhet ...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	
Punjab.	Mooltan ...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	
	Thull ...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	
	Lahore ...	...	...	...	...	...	...	1	...	...	..	...	...	...	...	...	
	Ludhiana ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Simla ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Delhi ...	...	...	...	...	...	...	2†	...	...	...	...	...	...	...	...	† One broken in transit.
Central Provinces.	Khandwa ...	1	...	...	...	...	...	1	1	..	...	...	...	...	...	...	
	Hoshangabad ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Pachmarhi ...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	
	Nagpur ...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	
	Jubbulpore ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
Berar.	Chikalda ...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	Akola ...	...	1	1	...	...	...	...	1	...	...	...	...	...	...	...	
	Makhla ...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	
Central India and Rajputana.	Neemuch ...	1	...	...	...	...	...	...	1	1	...	...	...	...	...	...	
	Nowgong ...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	
	Sutna ...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	
	Indore ...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Bickaneer ...	1	...	...	...	...	...	2	3	...	...	...	1	...	...	...	
	Sambhar ...	...	...	...	...	...	1	...	1	1	...	...	...	...	...	...	
	Ajmere ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Mount Abu ...	...	...	...	1	...	...	...	2	...	...	...	...	...	...	...	
	Pachbudra ...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	
	Jeypore ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bombay.	Jacobabad ...	...	...	...	...	...	...	1	1	...	..	...	...	...	...	...	
	Kurrachee ...	...	...	...	2	...	...	2	...	1	...	...	...	...	...	...	
	Rajkot ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Deesa ...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	

Return of the instruments issued to Meteorological Observatories in 1880-81.

	Station.	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer.	Wind vane.	Raingauge.	Measure glass for the raingauge.	Standard thermometers.	Lens.	Lantern.	Remarks.
Bombay—*contd.*	Surat	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Malegaon	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Poona	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	
	Sholapur	...	...	...	...	...	...	1	2	...	...	...	...	...	...	...	
	Belgaum	...	...	...	...	...	...		2	...	...	...	...	...	...	...	
	Karwar	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	
Madras and Coorg.	Gopalpore	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Masulipatam	...	...	...	...	1	1	...	...	1	...	...	...	...	...	...	
	Negapatam	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	
	Ootacamund	...	...	...	...	...	2*	...	1	...	...	...	...	...	...	...	* One broken in transit.
	Calicut	...	1	1	1	...	...	...	...	1	...	1	2	...	...	...	
	Mercara	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	
British Burmah.	Akyab	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Thyetmio	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Bassein	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Diamond Island	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	
	Moulmein	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	
Bay Island.	Nancowry	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
Extra Indian.	Katmandoo	...	...	...	...	...	1	...	1	1	1	...	...	...	...	...	
	Quetta	...	2†	...	...	...	...	...	...	...	...	...	...	...	...	...	† One broken in transit.
	Bushire	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	
	Aden	...	...	...	...	...	...	...	...	1	1	1	...	...	...	1	Original furniture.
	Amini Divi	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	
	Minor Stations not under the Meteorological Department	...	3	2	1	4	1	...	...	...	...	14	1	...	...	...	

METEOROLOGICAL OFFICERS AND OFFICE-WORK.

The general control of meteorological observatories and offices in the different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the past year:—

Province.	Superintending Officer.	Names.
Bengal and Assam ...	Meteorological Reporter, Government of Bengal	John Eliot, M.A. A. Pedlar.
North-Western Provinces and Oudh.	Meteorological Reporter, North-Western Provinces and Oudh.	S. A. Hill, B.Sc.

Province.	Superintending Officer.	Names.
Punjab	Meteorological Reporter, Punjab	Surgeon E. Lawrie, M.D.
Central Provinces	Sanitary Commissioner	J. A. C. Hutchinson, M.D.
	Meteorological Reporter, Government of India ...	H. F. Blanford, F.R.S.
Berar	Sanitary Commissioner	Dr. Little.
	Meteorological Reporter for Western India	F. Chambers.
		A. N. Pearson.
Central India and Rajputana	Meteorological Reporter, North-Western Provinces and Oudh.	S. A. Hill, B. Sc.
	Meteorological Reporter for Western India	F. Chambers.
		A. N. Pearson.
Bombay	Meteorological Reporter for Western India	F. Chambers.
		A. N. Pearson.
Madras	Meteorological Reporter, Government of Madras	N. R. Pogson, F.R.S.
Burmah ...	Meteorological Reporter, Government of Bengal	John Eliot, M.A.
		Alexander Pedlar.
	Sanitary Commissioner	W. Pearl, M.D.
	Meteorological Reporter, Government of India ...	H. F. Blanford.
Bay Islands ...	Senior Medical Officer, Port Blair	Surgeon W. Beatson, M.D.
	Meteorological Reporter, Government of India ...	H. F. Blanford.
Extra Indian Observatories	Meteorological Reporter, Government of Punjab	Surgeon E. Lawrie.
	Meteorological Reporter, Government of India ...	H. F. Blanford.

Up to the close of the year under report, no change had been made in the Reportership for Madras; but a Committee had been appointed by the Government of Madras, to report on the question of relieving the Government Astronomer, Mr. Pogson, of his work as Meteorological Reporter; and I have lately been informed that his daughter, Miss Pogson, has been appointed to this post. I have observed, in a previous part of this report, that since the latter part of 1880, there has been a considerable improvement in the regularity with which the registers of the Madras stations have been communicated to my office.

The work in Bengal and the North-Western Provinces has been carried on in the same thoroughly effective manner as in the former years; and the returns from the Office of the Meteorological Reporter for Western India have been communicated with great regularity.

Mr. Eliot was absent, on privilege leave, from the 4th August to the 4th November; during which interval, Mr. A. Pedlar officiated as Meteorologial Reporter to the Government of Bengal.

Mr. Chambers was absent, on privilege leave, from the 26th April to the 9th June; during which time, the duties of his office were temporarily undertaken by Mr. A. N. Pearson.

There has been a marked improvement in the work of the Punjab stations during the past year; and Dr. Lawrie's report shows that he is aware of the defects which some of them present, and which have arisen from long neglect; and doubtless the regular inspection which he proposes to exercise, will, in the course of time, place them on a satisfactory footing.

The following table shows the number of stations, the registers of which were sent to each of the Reporters, respectively, during the year under report:—

Provinces.	Meteorological Reporters.						Total.
	India.	Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	
Bengal and Assam	3	18	...	...	...	...	21
North-Western Provinces and Oudh	2	...	12	...	...	...	14
Punjab	1	...	...	11	...	...	12
Rajputana and Central India ...	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay	...	...	...	...	13	...	13
Madras, Mysore, and Coorg ...	3	...	...	...	...	12	15
Burmah	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	5	...	...	1	1	...	7
Total ...	36	19	16	12	22	12	117

This list does not include the registers of the Colaba observatory, of Goa, Jeypore, and Vizagapatam, which are furnished to the Meteorological Office with all the necessary reductions.

In Bengal, the North-Western Provinces, and Madras, the Meteorological Reporters superintend also the numerous rainfall registers of the district and subdivisional stations of their respective provinces, and prepare weekly returns of the rainfall; and in Bengal and Bombay, the Reporters have also charge of a system of daily reports received by telegraph,—in the case of the former from fifteen, in that of the latter, from ten stations; and the working of a system of storm signals for the protection of the port of Calcutta, and those of Bombay and five other stations on the west coast, respectively. The Meteorological Reporter for Bengal also administers a system of meteorological registration at sea.

Office Establishments.—The following table is a return of the number of employés in the offices of the several Meteorological Reporters, as far as information has

been received up to the end of the year under report. At Madras, the establishment of the Astronomical Observatory was employed in the work of reduction:—

	India.	Bengal.	North-Western Provinces.	Punjab.	Western India.	Total.
Head Clerks	1	*	1	†1	1	4
Computers	2	..	...	...	1	3
Clerks and Copyists	3	2	4	1	5	31
Tabulators	12	4				
Draughtsmen	2	...	...	...	...	2
Artisans	...	3	...	...	...	3
Peons and Menials	6	4	1	1	1	13

The offices of the Reporters for India and Bengal have been, as in former years under the management of Babu Fanindra Mohun Basu, and with the same very satisfactory results. But I regret to have to report that his health has been deteriorating for some years past, and that, in the last cold season, he was compelled to take leave for nearly three months to recruit; during which absence, the want of some competent man, to take temporary charge of his duties, was very prejudicially felt. Quite recently, he has again been compulsorily absent for many days, and the experiment of placing the Head Computer in charge of his duties having proved a failure, a serious burden has been thrown on Mr. Eliot, who holds general administrative charge of both offices during my absence at Simla. It has, therefore, become absolutely necessary to provide a Head Clerk for the Bengal Office, who may, on occasion, act as *locum tenens* for the Head Clerk of my own office, and a proposal to this effect is now before Government. ‡

Mr. Hill's Head Clerk, Babu Chintamony Ghosh, is reported of equally favourably. From the beginning of the year under report, he received an increase of pay, which Mr. Hill considers to have been well deserved.

WEATHER BULLETINS AND OTHER PUBLICATIONS.—The publications of the office will be noticed under the heads of—

Daily and weekly reports (including storm warnings).
Annual reports.
Other publications

Daily and weekly reports.—The system of daily reports has been continued, as described in the Administration Report for last year. The following more detailed description is extracted from a special report on the subject, recently prepared for the information of the Government of India.

The daily weather bulletins issued by the Calcutta Meteorological Office, are of two kinds; *viz.*, that issued by the general office, which relates to the whole of India, and that issued by the Bengal Office, which relates to the coasts of the Bay of Bengal only. The former gives the results of the weather telegrams received daily, from 50 stations in the fine season, and from 84 in the rains; of which latter number, 24 send reports of the

* The Head Clerk of the India Office acts in the same capacity for that of Bengal.
† Also Chief Observer.
‡ This has since been sanctioned.

rain fall only. From these telegrams, after certain reductions and corrections, a tabular statement is compiled, which is sent to the Government Press every evening; and the printed sheets, received next morning, are distributed, partly by hand, partly by post, to about sixty addresses in India and to twenty-one in England and foreign countries. This distribution is gratuitous.

From the 16th May to the 15th October, the report is prepared and issued at Simla; and, during this season, the tabulated data are supplemented by a short commentary, which is drawn up by myself, and, indeed, can be written only by a scientific officer. The regular working of this service demands, therefore, my constant presence; and, during its continuance, I am bound down to the station of issue, Sundays and holidays not being excepted. From the 16th October to the 15th May, the daily bulletins are issued from the Calcutta Office; and as I have to make my inspection tours during this season, and am of necessity absent for some part of the time, the verbal commentary is omitted. This has been the practice from the beginning. Certain complaints that have appeared occasionally in the newspapers, to the effect that the weather reports are not issued during the fine season, evidently have reference to the verbal summary, since the issue of the tabulated data (showing the barometric pressure, temperature, rainfall, &c., accompanied with short set phrases descriptive of the weather at each station,) is never interrupted. From the complaints above referred to, it may be gathered that the verbal summary is that part of the daily report to which the public attaches most importance, and the continuance and extension of which would serve greatly to popularise the reports.

In the Meteorological Office, a chart is prepared daily from the telegrams; and this is subsequently completed with the data received by post from the observatories which send no telegrams (about 60 in number). These charts are extremely useful in affording a general *aperçu* of the state of the weather all over India, and are of much use in drawing up the annual reports on storms, &c., but they are not published, save in a few exceptional instances, and in this connection.

The weather report issued by the Bengal Meteorological Office is intended to show the state of the weather around the coasts of the Bay and, inferentially, on the Bay itself. It gives a tabular statement, compiled from the telegrams, a sketch chart, and a verbal summary, drawn up by the Meteorological Reporter to the Government of Bengal. This officer is but rarely absent from head-quarters; and as hitherto, when he has been absent, I have been present and have taken over the work, there has been no interruption of the service since it was started in its present form, *viz.*, on the 1st April 1880; but as in the preceding case, the preparation of the chart and the verbal remarks depend on the constant presence of a scientific officer. This report is lithographed and printed in the Meteorological Office, and is distributed, on the afternoon of the day to which it refers, to the several Government offices and to 27 newspapers, merchants, and others, who subscribe for it at the rate of Rs. 2 per month.

During the rains, the circulation was larger, and several additional copies were subscribed for. Mr. Eliot reports that the monthly receipts from subscribers have not only sufficed to pay the additional establishment engaged for the printing and circulation; but also to leave a small balance to the credit of Government. In addition to the copies issued to subscribers, eighteen additional copies are supplied to various Government offices and officials, all of whom are more or less directly interested in the character

of the weather at the head of the Bay. The extension of the signal service and the publications of the daily report and chart, have thus been as successful as had been anticipated.

Mr. Eliot reports that the bad weather signals were only hoisted three times during the past year. The storm on each occasion, although cyclonic, was small in extent and of no great intensity, as measured by the barometric depression at its centre. They were all what may be termed 'south-west monsoon storms,' and hence the warning and danger signals were not hoisted in addition to the 'bad weather' signals. The three occasions on which they were hoisted at Saugor Island, Diamond Harbour, and Mud Point were

2nd June, for about 24 hours.
22nd September, for abont 21 hours.
14th October, for about 26 hours.

The Bombay storm service system does not include the publication of printed daily reports, but a manuscript copy of the report is sent to the Port Officer, who posts it in his office, and gives the information to the *Times of India*, for publication in the next morning's paper. A form, giving the principal item of information, is also filled up at the Meteorological Office, for daily publication in the *Bombay Gazette*.

In the event of threatening weather being reported from any of the coast stations, special telegraphic reports are called for from all the Government observatories in the neighbourhood of the disturbance; and if it should appear that the disturbance threatens any of the Bombay ports, enumerated in the following list, warning telegrams are sent to them:—

Kurrachee.	Vengurla.
Bombay Castle.	Vengurla Rocks.
Prince's Dock	Malvan.
Colaba Point	Karwar.
Kenneri	Oyster Rock Light-House.
Ratnagiri.	Kumta.

A description of the storm signals and their signification is appended to Mr. Chambers' report (Appendix E).

During the past year, special reports have been called for on two occasions; but it has been necessary to issue warning telegrams, only once, to the ports to the south of Bombay, *viz.*, on the 21st November 1880.

The Reporters for Bengal, the N.-W. Provinces, and Bombay published monthly summaries of the meteorological observations of all observatories administered by them respectively; and in the case of Bengal and the N.-W. Provinces, weekly and also monthly reports of the rainfall at raingauge stations. The Reporter for the Punjab communicates a monthly abstract of the observations of his province to the Sanitary Commissioner of the Punjab, and prepares a special climatological statement for the Punjab Government.

A weekly and monthly abstract of the observations recorded at the Alipore Observatory is published in the *Calcutta Gazette*.

ANNUAL REPORTS.—The report on the meteorology of the year 1879 was completed and the whole in the printer's hands by the 28th December 1880. The preparation had been delayed to some extent by the tardiness of the Madras registers, but towards

the latter part of the year an improvement was manifested, and the hiatus, arising from this cause, in the report for 1879, are fewer than in that of the preceding year.

The report gives tables of temperature for 123 stations, and rainfall returns of 365 stations, being an increase of seven of the former and twelve of the latter. The returns of pressure, wind direction, and other meteorological elements are nearly as numerous as those of temperature. The elements tabulated in the appendices are as follow:—

	Stations.
Equilibrium temperature of solar radiation	106
Temperature of nocturnal radiation	100
Mean and extreme air temperatures	123
Sea-level equivalents of mean temperature...	101
Means and extremes of atmospheric pressure	119
Sea-level equivalents of atmospheric pressure	98
Direction and movement of winds	118
Temperature of evaporation	111
Tension of atmospheric vapour...	120
Mean relative humidity	120
Mean proportion of clouded sky	118
Inches of rainfall in each month of 1879	365
Number of days on which rainfall was measured	365

The descriptive letter press discusses the meteorology of the year in detail. It includes nineteen numbered tables, giving the average values of all the more important elements, for all stations that have furnished registers for three years and upwards; and the report is illustrated with eight plates,—one of which is a chart showing the positions of all observatories and raingauge stations; three represent the distribution of pressure, temperature, and winds in each month of the year; and the remainder illustrate particular phases of weather, *viz.*, the conditions of the cold weather rainfall and the land-formed cyclones that characterise the rainy season.

The original observations at six stations in India, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras, which have formed an appendix to previous reports, have now been issued in monthly parts as a distinct publication, and form a small 4to volume, prefaced by a detailed description of the stations and the instruments employed. The final sheets, completing the volume for 1879, were issued in February last.

Mr. Hill has also published independently a summary of the observations of the observatories which he superintends; and Mr. Chambers furnished, for the General Administration Report of the Presidency, a sketch of the local meteorology.

OTHER PUBLICATIONS.—Part IV of the Indian Meteorological Memoirs was published during the year. It contains a paper, by Mr. F. Chambers, on the winds of Kurrachee, being a discussion of three years' anemographic records at that station, illustrated by eight plates. Part V, containing papers by Mr. Hill and myself, was nearly ready for issue at the close of the year.

Mr. Hill has published a table giving the monthly total rainfall at each station in the North-West Provinces for 1880, the number of rainy days in each month, and the average monthly rainfall of each place; and a chapter on the meteorology of the North-West Himalaya was written by him for the "Hill Districts" volume of the North-Western Provincial Gazetteer, and will be published with some additions in Part VI of the Meteoro-

logical Memoirs, together with an index of the six parts, thus completing volume I of this publication.

Mr. Chambers has written and communicated to 'Nature' a short paper on 'Abnormal Variations of Barometric Pressure in the tropics and their relations to sunspots, rainfall, and famines,' and a few copies were printed in Bombay for the information of Government.

A short note accompanying some illustrations of remarkable hailstones was contributed by myself to the Asiatic Society, and published in the Proceedings of the Society for June 1880, and a short paper, in German, on the causes affecting temperature in India, was communicated to the Vienna Zeitschrift and published in the October number. The subject-matter of this paper, considerably expanded, is included in the Report on the Meteorology of 1879, and will also appear in a separate form in the Journal of the Asiatic Society of Bengal for the present year.

A comparative return of the rainfall of India in 1880 was prepared, and, together with illustrative charts, submitted to Government, for communication to the Secretary of State, on the 18th March 1881.

Appendix H gives a list of the institutions, &c., to which the publications of the office are presented, including those which furnish their own publications in exchange.

LIBRARY.

The Library is now contained in four large double book-cases, and is in excellent condition. The additions made during the past year are enumerated in the following list:—

Presentations to the Library from the 1st April 1880 to the 31st March 1881.

Place.	Donor.	Title of Work.
Adelaide ...	C. Todd, Esq., C.M.G., F.R.A.S.	Meteorological observations made at the Adelaide Observatory during the year 1878.
Algiers ...	Meteorological Service ...	Résumé des observations. January to May 1880.
		Tableau récapitulatif des quantités des pluies tombées quotidiennement. Septembre 1879.
		Quantités de pluie tombées mensuellement. Septembre 1879 à Avril 1880.
		Bulletin Météorologique du Gouvernement général de l'Algérie; Nos. 1563 to 1914.
		Résumé climatologique. January to July 1880.
Allahabad ...	Meteorological Office ...	Sketch of the Meteorology of the year 1879 in the North-Western Provinces and Oudh and Eastern Rajputana.
Amsterdam ...	Royal Academy of Sciences ...	Jaarboek 1877 and 1878.
		Verslagen en Mededeelengen, Volumes XII to XIV.
		Processen Verbaal, 1877-78, 1878-79.
Batavia ...	Observatory ...	Magnetical and Meteorological Observations, Batavia, Volume IV.
		Rainfall in the East Indian Archipalago, 1st year 1879.

Presentations to the Library from the 1st April 1880 to the 31st March 1881—continued.

Place.	Donor.	Title of Work.
Berlin ...	Dr. Gustav Hellman ...	Die Organisation des Meteorologischen Dienstes in den Hauptstaaten Europas.
	K. Statistisches Bureau	Preussische Statistik LIV. Meteorologische Beobachtungen im Jahre, 1879.
Bombay ...	Government of Bombay ...	Sixteenth Annual Report of the Sanitary Commissioner for the Government of Bombay, 1879.
	Meteorological Office ...	Brief Sketch of the Meteorology of the Bombay Presidency in 1879.
		Abnormal variations of barometric pressure in the Tropics and their relation to sunspots, rainfall, and famines.
Brussels ...	Observatoire Royal de Bruxelles	Annales Météorologiques. Observations de Bruxelles, 1874 and 1875, and October 1879.
		Annales météorologiques. Observations des stations climatologiques, July to December 1879.
		Observations météorologiques faites aux stations internationales de la Belgique et des Pays-Bas, January—May 1879.
Budapest ...	Central—Anstalt für Meteorologie und Erdmagnetismus.	Jahrbücher, Band VI, Jahrg. 1876, and Band VII, Jahrg. 1877.
Calcutta ...	Accountant General, Bengal ...	Civil Account Code, Volume I, Second Edition.
	Henry F. Blanford, Esq. ...	High Atmospheric pressure of 1876-78 in Asia and Australia, in relation to the sun-spot cycle.
		Note to accompany some drawings of large hailstones by Colonel H. H. Godwin-Austen and S. E. Peal, Esq.
		The Indian Moonsoon Rains.
	Geological Survey of India ...	Memoirs of the Geological Survey of India, Volume XV, Part 2; Volume XVI, Parts 2 and 3; Volume XVII, Part 2.
	Government of Bengal ...	Hindustáni-English Dictionary, Dr. Fallon.
		Twelvth Annual Report of the Sanitary Commissioner for Bengal for 1879.
		Report on the Internal Trade of Bengal for 1879-80.
		Report on the Administration of Bengal for 1879-80.
		Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, on 7th June 1879.
	Government of India, Home, Revenue and Agriculture Department ...	Report of the Meteorological Council of the Royal Society for the year ending 31st March 1879.
		Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the annual visitation of the Royal Observatory, 7th June 1879.
		General Report on the operations of the Survey of India during 1878-79.
		Preliminary Report by the Committee on Solar Physics appointed by the Lords of the Committee of Council on Education.
		Report on the condition and proceedings of the Government Observatory, Colaba, for the year which ended with the 30th June 1880.

Presentations to the Library from the 1st April 1880 to the 31st March 1881—continued.

Place.	Donor.	Title of Work.
Calcutta ...	Government of India, Home, Revenue and Agriculture Department ...	Progress Report of Forest Administration in the Hyderabad Assigned Districts for 1879-80.
		Progress Report of Forest Administration in the Province of Assam for the year 1879-80.
		Oesterreichische monatschrift für den orient, 15th November 1880.
		Administration Report upon the proceedings of the Madras Observatory and Meteorological Department for the year 1879.
		Report of the Indian Famine Commission, Part II.
	Government of India, Military Department.	General Report on the Operations of the Marine Survey of India for the year 1878-79.
	Government Mathematical Instrument Department.	Nautical Almanac for 1876, 1877, and 1878.
	Sanitary Commissioner, Government of India.	Annual Report for 1879.
	St. Xavier's College Observatory	Results of Observations taken at the St. Xavier's College Observatory, Calcutta, January—December 1880.
	Surveyor General of India ...	General Report on the Operations of the Survey of India during 1878-79.
Christiania ...	Royal Observatory ...	Études sur les mouvements de l'atmosphére.
Copenhagen ...	Instituts Météorologiques de Norvege de Danemark et de Súede.	Bulletin Météorologique du Nord; May, August, and December 1879; January to April and June to December 1880 and January 1881.
	Danske Meteorologiske Institut	Oversigt No. 3 of 1879; Nos. 1 and 2 of 1880.
		Annuaire météorologique 1879.
Dehra Dún ...	Trigonometrical Branch, Survey of India.	Great Trigonometrical Survey; Synoptical Volumes I—VI and VIII and IX.
Dublin ...	Royal Dublin Society ...	Transactions, Volume I, parts 1—12; Volume II, parts 1 and 2.
		Proceedings, Volume I, parts 1—3; Volume II, parts 1—6.
Edinburgh ...	Scottish Meteorological Society ...	Journal New Series, Nos. LVII to LXIII.
Goa ...	Royal Observatory ...	Observacões meteorologicas de Goa referidas as 1st and 2nd semestre do Anno de 1879, and 1st semestre do Anno de 1880.
Guatemala ...	Instituto Nacional de Guatemala	Resumen de las observaciones meteorologicas hechas March 1879,--February 1880.
		Observaciones meteorologicas; January, February, and June—August 1880.
Hamburgh ...	Deutsche Seewarte ...	Monatliche Übersicht der Witterung für jeden Monat des Jahres 1878, Jahrg. III.
		Monatliche Uebersicht der Witterung; September to December 1878, January and February 1879, January—July 1880.
		Wetterbericht, Volume IV, 61—366; Volume V, Nos. 1—59.
		Resultate aus den meteorologischen Beobachtungen angestellt an fünfundzwanzig Königlich Sächsischen Stationen, in den Jahren 1874 and 1875.

Presentations to the Library from the 1st April 1880 to the 31st March 1881—continued.

Place.	Donor.	Title of Work.
Hamburgh ...	Dentsche Seewarte ...	Regen, Hägel und Gewitter im Indischen ocean No. 2, aus dem Archiv der Deutschen Seewarte; I Jahrg. 1878.
	Dr. A. Sprung ...	Studien über den Wind und seine Beziehungen zum Luftdruck.
Hongkong ...	Government of Hong-Kong ...	Meteorological Observations; February to November 1880.
Iowa U. S. ...	Central Office, Iowa Weather Service ...	First biennial report of the central station.
		Iowa Weather Report for 1878, 1st, 2nd, and 3rd quarterly numbers; for 1879 1st quarterly No.
		Bulletin No. 73—77, 79—87, 89 and 90.
		Lantern Signals I. W. S.
		Flag Signals I. W. S.
		Directions for crop report of the I. W. S.
Jeypore ...	Meteorological Department ...	Jeypore Meteorological Report for the year 1879.
Leipzig ...	Meteorological Observatory ...	Monatliche Berichte über die Resultate aus den meteorologischen Beobeobachtungen, angestellt an den Königlich Sächsischen Stationen im Jahre 1878; auch 1879.
	Professor Dr. C. Bruhns ...	Bericht über das meteorologische Bureau für Wetter Prognosen im Königreich Sachsen, für das Jahr 1879.
		Resultate meteorologischen Beobachtungen in Januar 1879.
London ...	G. J. Symons, Esq. ...	Symons' Monthly Meteorological Magazine; April 1880 to February 1881.
	Meteorological Office ...	Weekly Weather Report, Volume III, Nos. 9 to 53; and Volume IV, Nos. 1—7.
		Report of the Meteorological Council of the Royal Society for the year ending December 1868, and also for the years ending 31st March 1879 and 31st March 1880.
		Report on the Meteorology of Kerguelen Island.
		Daily Weather Reports, 1st January 1879 to 30th June 1880.
		Bulletin International du Bureau Central Met. de France, Volume XXIII and Volume XXIV.
		Quarterly summary of rainfall and temperature in the British Islands.
	Meteorological Office ...	Hourly Readings at the 7 observatories; January to December 1879.
		Contributions to our knowledge of the meteorology of the Arctic regions, Part II.
		Meteorological Observations at stations of the second order, for the year 1878.
		Aids to the study and forecast of weather.
		Description of the Card Supporter for sunshine recorders adopted at the Meteorological Office.
	Royal Asiatic Society ...	Journal, Volume XI, part III; Vol. XII, parts I—IV; Vol. XIII, part I.

Presentations to the Library from the 1st April 1880 to the 31st March 1881.—continued.

Place.	Donor.	Title of Work.
London	Royal Observatory, Greenwich	Greenwich Magnetical and Meteorological Observations, 1877 and 1878.
	Royal Society	Proceedings Vol. XXIX, Nos. 199—201; Vol. XXX, Nos. 202—206.
	Society of Arts	Journal Nos. 1370 and 1424 to 1475.
	Meteorological Society	Quarterly Journal, Vol VI, Nos. 33—36.
Madrid	Observatory	Observaciones Meteorologicas efectuades en el Observatorio de Madrid, durante el ano 1876, 1877, and 1878.
Mauritius	Meteorological Society	Monthly Notices; New Series, Nos. 9 to 13.
Manchester	Literary and Philosophical Society	Memoirs 3rd series, Vol. VI (1879).
		Proceedings Vols. XVI, XVII, XVIII, and XIX (1877-78-79-80).
Melbourne	Observatory	Monthly record, November and December 1879, and January to August 1880.
Mexico	Central Meteorological Observatory	Revista Cientifica Mexicana. Tome I, Nos. 1—9 and 12.
		Bolletin Tome V, Nos. 15—80, 91—170, 186—219; Tome VI, Nos. 1—6.
		Informe que el director del observatorio *meteorologico Central* presenta à la Secretaria de Fomento acerca de los trabajos verificado en aquella officina durante los anõs de 1878 y 1879.
		Annales del ministerio de Fomento de la Republica Mexicana, Tome III.
Milan	Royal Observatory, Brera	Sui Temporale osservati nell' Italia Superiore durante l'anno 1877.
Montsouris Paris	Montsouris Observatory	Annuaire for 1880.
Munich	K. C. Akademie der Wissenschaften	Sitzungsberichte; Band IX, Hefte II to IV, and Band X, Hefte I to IX.
		Abhandlungen der Mathmatisch Physicalischen Classe, Band XLVIII.
	K. Sternwarte	Meteorologische und Magnetische Beobachtungen, 1876 to 1879.
	Professor Dr. Carl Arendts	Deutsche Rundschau für Geographie und Statistik, Vol. II, Nos. 7—12; Vol. III, Nos. 1—6.
	Professor Dr. Karl A. Zittel	Ueber den geologischen Bau der Libyschen Wüste.
New Haven	Connecticut Academy of Arts and Sciences.	Transactions Vol. V, Part I.
New York	Central Park Observatory	Abstract of registers from self recording instruments; December 1879.
		Annual Tables for 1879, and January to November 1880.
Oxford	Radcliffe Observatory	Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the years 1876—1879.
Paris	Bureau Central Météorologique de France	Bulletin international, Vol. XXIII, Nos. 1—58, 129—135, 151, 248—254; Vol. XXIV, Nos. 58—225.
		Annales 1878, and 233—366; Vol. XXV, Nos. 1—48.

Presentations to the Library from the 1st April 1880 to the 31st March 1881.—continued.

Place.	Donor.	Title of Work.
Paris ...	Société Météorologique de France ...	Annuaire XXVII, Bulletin des Séances, feuilles 22 and 23, 1879.
		Annuaire XXVII, Tableaux Météorologiques, f. 5—12 of 1879.
		Annuaire XXVIII, 1880, 1st & 2nd Trimestre.
Perth (W. Australia).	Surveyor General ...	Meteorological Report for 1879.
Philadelphia ...	Franklin Institute ...	Journal, Vol. CV, No. 629; Vol. CIX, Nos. 651, 653, 654; Vol. CX, Nos. 655—656, 658—660; Vol. CXI, 661—662.
Prag ...	Imperial Observatory ...	Astronomische, magnetische und meteorologische Beobachtungen, 1879.
Rangoon ...	Government of British Burma ...	British Burma Gazette, Vols. I and II.
Rome ...	Professor Constantino Pettie ...	Congresso internazionale de meteorologia a Roma.
		Rapports présentés au deuxiéme congress météorologique international de Rome.
		Rapport sur les travaux du deuxieme congres international des météorologistes reunis á Rome, du 14 au 22 Avril 1879—Procés verbaux et appendices.
Salford (England)	Dr. T. Tatham ...	Report of the health of Salford for the years 1877-78, with statistical abstracts for the decennium, 1869—78.
San Fransisco ...	Trustees of the Lick Observatory.	Report to the Trustees of the "James Lick Trust" of observations made on Mount Hamilton, with reference to the location of the Lick Observatory.
Singapore ...	Colonial Surgeon, Straits Settlements.	Straits Settlements Meteorological Returns for 1879.
St. Louis ...	Washington University ...	Missouri Weather Service, 1880, April, June, August to October; January 1881.
St. Petersburgh ...	Physical Central Observatory ...	Annalen des physikalischen Central Observatoriums, Vols. I & II of 1878.
		Repertorium für Meteorologie, Band V, Heft 2; Band VI, Heft 1.
Sydney ...	Observatory ...	Minutes of Proceedings of the Intercolonial Meteorological Conference, held at Sydney on the 11th, 13th, and 14th November 1879.
		Abstract of Meteorological Observations in New Zealand, 1879, April—September
Syracuse ...	Osservatorio di Siracusa ...	Meteorological Observations, Anno I, Nos. 1—43; Anno II, Nos. 7—12; Anno IV, Nos. 1—12.
Tokio (Japan) ...	Imperial Meteorological Observatory ...	Meteorological Observations taken at Wakayama, July 1879 to April 1880.
		Meteorological Observations taken at Hiroshima, January 1879 to March 1880.
		Meteorological Observations taken at Nagasaki, January 1879 to February 1880.
		Meteorological Observations taken at Tokio, January 1879 to June 1880 (monthly).
		Meteorological Observations taken at Tokio, 1st January 1879 to 19th July 1880 (weekly).

Presentations to the Library from the 1st April 1880 to the 31st March 1881.—continued.

Place.	Donor.	Title of Work.
Tokio (Japan) ...	Science Deptartment, University of Tokio, Japan ...	Memoirs, Vol. III, Part I.
		Report on the Meteorology of Tokio for 1879.
Toronto ...	Meteorological Office, Dominion of Canada ...	Monthly Weather Review, January to April, June and July; September to December 1880; January 1881.
		General Meteorological Register for 1880.
		Report for 1878.
Turin ...	Osservatorio Astronomico dell Universita degli Studi di Torino	Effemeridi del sole, della luna e dei principali pianeti, calcolate per Torino in tempo medio civile di Roma, per l'anno 1880-81.
		Applicazione dei principii della meccanica analitica a problemi note di Alessendro Dorna V.
		Boletino, Anno, XIV (1879).
		Ricarche intorno alle solcature delle elitre dei Ditiscidi.
		Nota intorno allo scheletro del Bombinator Igneus (Laur).
		Della Scelta Sessuble negli Anfibi Anuri.
		Nota intorno alla colorazione naturale delle ossa di una specie di anfibis anuro.
		Nota sopra un caso di colorazione naturale delle traghee di un insetto.
Upsala ...	Dr. H. Hildebrand, Hildebrandsson.	Marche des isotherms au printemps dans le nord de l'Europe
	Observatoire Météorologique de l'Universite d'Upsal.	Bulletin mensuel, Vol. XI, Nos. 7—12.
Utrecht ...	Koninklijk Nederlandsch Meteorologisch Institut.	Jaarboek for 1879, Erste Deel.
Vienna ...	Dr. J. Hann ...	Untersuchungen über die Regenverhaltnisse von Osterreich-Ungarn.
		Zeitschrift Band XV, April to December 1880, and Band XVI January and February 1881.
		Zeitschrift für Wissenschaftliche Geographie, September 1880.
		Die Vertheilung des Regenfalls über Oesterreich, in der Periode vom. 2—15, August 1880, und deren Beziehung zur Vertheilung des Luftdrucks.
		Bericht über die Fortschritte der geographischen Meteorologie.
	K. K. Central Anstalt für Meteorologie und Magnetismus ...	Internationaler telegraphischer Wetterbericht Jahg. IV, Nos. 60—366; Jahg. V, Nos. 1—56.
		Jahrbucher, Jahg. 1877, Neue Folge, Vol. XIV; Erster Theil Jahrg. XV 1878; Jahrg. XVI 1879.
	K. K. Geologische Reichsanstalt	Verhandlungen Nos. 10 to 17 of 1879, and Nos. 1—11 of 1880.
	Royal Academy of Sciences ...	*Boltzman.*—Ueber die Beziehung der Diffusionsphänomene zum zweiten Hanptsatze der mechanischen Wärmetheorie.
		Ueber die auf Diamagnete wirksamen Kräfte.
		Zur Theorie der Gasreibung.

Presentations to the Library from the 1st April 1880 to the 31st March 1881.—continued.

Place.	Donor.	Title of Work.
Vienna	Royal Academy of Sciences	*Ami Boue.*—Uber die Oro-Potamo-Limne (seen) und Lekavegraphie (Becken) des Tertiaren der europäischen Türkei. *Ciamician.*—Spectroskopische Untersuchungen. *Füllig.*—Zur Theorie der Metallthermometer. *Lisnar.*—Uber einen Local-Einfluss auf die magnetischen Beobachtungen in Wien, in der Periode 1860-1871. *Mach* und *Weltrulesky.*—Uber die Formen der Funkenwellen. *Mach* uud *Donbrava.*—Beobachtungen über die Unterschiede der beiden elektrischen Zustände. *Makouesky* und *Tschermak.*—Meteoritenfall bei Teisehitz in Mähren. *Neissl.*—Bahnbestimmung zweier am 12 Janner 1879, in Böhmen und den angrenzenden Ländern beobachteten Feuerkugeln. *Sehöttner.*—Ueber die Ermittlung der Coëfficienten der inneren Reibung in zähen Flüssigkeiten, durch Fallversuche. *Stefan.*—Ueber die Diffusion der Flüssigkeiten. Ueber die Bezichung zwischen der Wärmestrahlung und der Temperatur. Ueber die Abweichungen der Ampereschen Theorie des Magnetismus von der Theorie der elektromagnetischen Kräfte. Ueber die Tragkraft der Magnete. v. *Sterneck.*—Ueber die Aenderungen der Refractions-Constante und Störungen der Richtung der Lothlnie im Gebirge. *Tschermak.*—Der Meteoritenfall bei Teischitz in Mähren I and II. v. *Waltenhofen.*—Ueber das magnetische Verhalten des pulverförmigen Eisens. Ueber die elektrische Durchbohrung des Glases. Auzeiger: Mathematisch-Naturwissenschaftliche Classe Nos. 20—28 of 1877; 1—28 of 1878; 1—27 of 1879, and 1—19 of 1880. *Anton.*—Bestimmung der Bahn des Planeten (154) Bertha. *Domalip.*—Ueber die magnetische Einwirkung auf das durch die negative Entladung in einem evacuirten Raume erzeugte Fluorescenzlicht. *Becka.*—Ueber die Bahn des Planeten Ino (173). v. *Ettingshausen.*—Bestimmung der absoluten Geschwindigkeit fliessender Elektrizität aus dem Hall'schen Phänomen. *Exner.*—Zur Theorie der incontansten galvanischen Elemente. Zur Theorie des Volta'schen Fundamentalversuches. *Finger.*—Ueber den Einfluss der Rotation des Erdsphäroids auf terrestrische Bewegungen, insbesondere auf Meeres und Windströmungen.

Presentations to the Library from the 1st April 1880 to the 31st March 1881—concluded.

Place.	Donor.	Title of Work.
Vienna ...	Royal Academy of Sciences ...	*Gegenbauer.*—Ueber Sturm'sche Reihen.
		Hann.—Untersuchungen über die Regenverhältnisse von Oesterreich—Ungarn, I and II.
		Klönne.—Die periodische Schwankungen des Wasserspiegels in den inundirten Kohlenschächten von Dux in der Periode vom, 8 April bes 15 September 1879.
		Lang.—Bemerkungen zu Cauchy's Theorie der Doppelbrechung.
		Puluj.—Beitrag zur Erklärung des Zöllner'schen Radiometers.
		Rutlinger und *Urbanitsky.*—Ueber die Erscheinungen in Geissler'schen Rohren unter äusserer Einwirkung.
		Ruling.—Bestimmung der Bahn des Planeten (178) Belisana.
		Tinter.—Bestimmung der Polhöhe auf dem Observatorium der k. k. technischen Hochschule in Wien.
Vizagapatam ...	A. V. Nursingrow, Esq. ...	Results of Meteorological observations recorded at the G. V. Juggarow observatory, Vizagapatam, during 1879.
Washington, U.S.	Chief Signal Office, War Department.	International Bulletin, 1st January, 28th February, and 10th June 1877; 9th June 1879 to 22nd October and 10th to 3rd May 1880.
		Monthly Weather Review, January and April to December 1880.
		Daily Bulletin of the Signal Service, U. S. A., with the Synopses probabilities and facts, 1877, April and May.
	Cleveland Abbe ...	Physics of the Globe.
	Philosophical Society ...	Bulletin, Vols. I to III.
	Smithsonian Institution ...	Smithsonian Report for 1878.
	United States Coast and Geodetic Survey.	Pacific Coast pilot; Aliaska—Appendix I, Meteorology and Bibliography.
	United States, Naval Observatory.	Meteorological Observations made at the U. S. Naval Observatory during the year 1876.
		The West Coast India-Cyclone of December 19th and 30th April 1867.
		A subject index to the publications of the U. S. Naval Observatory, 1845-1875.
Wellington ...	Meteorological Office, New Zealand.	Abstract of Meteorological Observations in New Zealand for the quarter ending December 1879 and January to October 1880.
Zi-ka-wei ...	Magnetical and Meteorological Observatory.	Bulletin Mensuel, 1879 October to December, with title page; 1880 January to November.
		On the storms of the Chinese Seas, and on the storm of the 19th and 20th March 1880.
		Perturbation magnétique du 11 au 14, et du 18 au 19 Août 1880.
Zurich ...	Swiss Meteorological Institute ...	Schweizerische meteorologische Beobachtungen, for 1877, and Supplement Band; and January to December 1880, pp. 1—228.

Purchases for the Library.

American Journal of Science and Arts, Vol. XIX, Nos. 109 to 114, and Vol. XX, Nos. 115 to 120; Vol. XXI, Nos. 121—122.
Annalen der Physik und Chemie, Nos. 1 to 13 of 1880; Nos. 1 and 2 of 1881.
Comptes Rendus de l'Academie de Sciences; Tome LXXXIX, Nos. 14 and 15 and Tables; Tome XC, Nos. 1—14, 16—26 and Tables; Tome XCI, Nos. 1—18 and 20—26; Tome XCII, Nos. 1—8.
Hoffmeyer's Charts; June to November 1876.
La Nature —— 8me Année, Nos 340 to 391; 9me Année, Nos. 392 to 405.
Nature — Index and title page of Vol. XXI; and Nos. 494 and 541 to 592.
Philosophical Magazine, Vol. IX, Nos. 53 to 58; Vol. X, Nos. 59 to 64; Vol. XI, Nos. 65—67.
Weather Charts and Storm Warnings, R. H. Scott,
The Analytical Theory of Heat, J. Fourier.
A Physical treatise on electricity and magnetism, Vol. I and II, Gordon.
A Treatise on Natural Philosophy, Vol. I, Part I, Thomson and Tait.
Mechanical Theory of Heat; Clausius.
Thermodynamics. Baynes.
Magnetical and Physical papers by G. G. Stokes, Vol. I.

H. F. BLANFORD,
Meteorological Reporter to the Govt. of India

August 24th 1880.

APPENDIX A.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Bengal for the year 1880-81.

DURING the official year 1880-81, meteorological observations were taken systematically and continuously at one first-class observatory, seven second-class observatories, and twelve third-class observatories in Bengal and Assam.

I took privilege leave for three months, from 4th August to 4th November; during this interval Mr. Alexander Pedler, Professor of Chemistry, Presidency College, who has on two previous occasions officiated for me, acted as Meteorological Reporter to the Government of Bengal.

The first-class observatory at Alipore continues to be worked under the direct superintendence of the Meteorological Reporter to the Government of India. I visited it occasionally during his absence on duty at Simla from May to November, during which period, the charge of the India office and the local superintendence of the Alipore observatory and the Time Ball service was placed in my hands.

Second-class Observatories.—These are seven in number, as during the previous year; five are in Bengal and two in Assam. The following table gives the names of the superintendents and observers during the previous year:—

Stations.	Superintendents.	Superintendents' allowance.	Observers.	Observers allowance.	Assistant Observers.	Assistant Observers' allowance.
Sibsagar ...	Dr. R. M. Meiklejohn, M.D.[1] Babu Dandadhar Dutt Barua[2]	30	Babu Dandadhar Dutt Barua.	30	Babu Brikodar Dutta ...	10
Goalpara ...	Dr. J. Slane[3] ... „ J. McNaught[4] ...	30	Maniruddin Ahmed ...	30	Kadimuddin ...	10
Patna ...	„ B. Simpson, M.D.[5] ... „ R. Bird, M.D.[6] ...	30	Munshi Mohabat Lal ..	30	Muddun Mohan Lal ...	10
Hazaribagh ...	„ R. Cobb, M.D. ...	30	Babu Kedar Nath Mukerjee[7] ... Raheemoola[8] ...	30	Mohamed Amir ...	10
Chittagong ...	.....	...	A. D. Sanges[9] ... E. Pereira[10] ...	32	J. H. Ensel[11] ... J. Dias[12] ... A. D. Sanges[13] ...	13
Saugor Island	.....	...	H. H. Peters[14] ... W. C. Ghose[15] ...	45		
Cuttack ...	.....	...	J. C. Smith ...	32	H. W. Alley[16] ... T. Breakey[17] ...	13

[1] To 5th October, and since 7th November 1880.
[2] From 6th October to 6th November 1880.
[3] To 9th January 1881.
[4] Since 10th January 1881.
[5] To 27th December 1880.
[6] Since 28th December 1880.
[7] To 8th April 1880.
[8] Since 9th April 1880.
[9] To 6th May 1880.
[10] Since 7th May 1880.
[11] To 11th April 1880, from 23rd January to 22nd February, and 7th to 23rd March 1881.
[12] Since 24th March 1881.
[13] From 12th April 1880 to 22nd January 1881 and 23rd February to 6th March 1881.
[14] To 16th November, and since 28th November 1880.
[15] From 17th to 27th November 1880.
[16] To 31st December 1880, and since 1st March 1881.
[17] From 1st January to 28th February 1881.

No change has been made in the extent and character of the work at these stations during the past year. The self-recording anemographs at Hazaribagh, Chittagong, Saugor Island, and Cuttack have been at work during the whole year, and the traces forwarded regularly to the Calcutta office. Three of these anemographs were inspected during the cold months, *viz.*, those at Hazaribagh, Chittagong, and Cuttack. Sanction was obtained for the erection of a small building at Bankipore for the reception of the anemograph. The question of the removal of the observatory to another site, mentioned in my last Administration Report for 1879-80, was finally settled by my visiting Patna in December. After comparing the proposed site in the grounds of the Temple School of Medicine with the present position of the observatory in an exposed and unprotected portion in front of the Telegraph office, I came to the conclusion that whilst, as far as exposure, &c., is concerned, there is little to choose between the two sites, the proposed site is much better protected, and is much more accessible to the observer. The observations will not, I believe, be affected by the change of site, whilst they will certainly be improved in character, by the observatory being situated in the compound of the Temple School of Medicine, where the observer has a house as head clerk of the office of the Temple School. The observer has arranged to have a double set of observations taken during the present year—one at the new site and the other at the old observatory. The question of this transfer will be finally decided at the end of the present year, from a comparison of these observations. If the comparison indicates that the conditions of exposure of the instruments at the new site are nearly identical to what they are at the old site, the observatory will be finally transferred to its new site in the beginning of 1882. Meanwhile, as none of the hill stations are provided with self-recording anemographs, I proposed that the one originally intended for erection at Bankipore should be transferred to Darjeeling. As this has met with the approval of the Meteorological Reporter to the Government of India, I hope to be able to carry the proposal into effect during the present year.

Sanction for the transfer of the Assam Observatory, hitherto maintained at Goalpara, to the new civil station and head-quarters of Dhubri, was obtained during the year. After considerable delay, the new shed for the ordinary instruments was erected in Dhubri, but the house for the anemograph has not yet been commenced. No provision was made in the original plans for the housing of the barometer. As it was found impossible to obtain a suitable position for it in the Civil Surgeon's office or house, it became necessary to modify the plans for the anemograph house, so as to fit it to receive the barometer in addition. Further delays also occurred, due to the illness of the Superintendent and his absence from the station. The grant for the erection of the house lapsed at the end of the official year, and application has been made for the renewal of the sanction. I trust that no further delays will arise in the erection of the anemograph house at Dhubri. Meanwhile, the observatory has been transferred from Goalpara to Dhubri.

My opinion of the observers at these stations, and of the character of the observations taken by them, is almost identical with what it was last year. One of the stations, Sibsagar, has not been visited by either Mr. Blanford or myself; and although, so far as I can judge from the returns sent in, the observer does his work satisfactorily, I hope to be able to visit it next cold weather. It was, however, inspected by the Chief Commissioner of Assam, Mr. Elliott, when he visited that station during his last cold-weather tour. He wrote in the visitors' book that it was in a very satisfactory condition. The remaining six stations have all been visited during the past two or three years, either by Mr. Blanford or myself. No change has been made in the extent or character of the work done at these observatories. In addition to the two sets of observations of the various instruments at 10 A.M. and 4 P.M., and also of the maximum and minimum thermometers at the usual hours, two special and additional sets of observations are taken at these stations. The first is a daily complete set of observations taken at the local time, corresponding to 7 A.M., Washington time. These are, after preparation and reduction at the head office, transmitted to the United States, for incorporation in the International Meteorological Observations and Charts, which now form an important and characteristic feature of the scientific work of the United States Meteorological Department. In

addition to this hourly observations are taken on four days of each month—the 7th, 14th, 21st, and 28th—in order to obtain accumulated observations, from which to deduce the average and normal diurnal changes of pressure, humidity, vapour tension, amount of cloud, &c. These were originally proposed to be taken for three years. The work has now been going on for upwards of six years at the majority of my second-class stations, and it is now, I think, a question, open for consideration whether these observations, which are very trying to the observers, might not be suspended for a while, and other additional observations, equally important in their nature, introduced for a time.

Third-class Observatories.—These are, as during the preceding year, twelve in number. Ten are in Bengal, one (Akyab) in Burmah, and the remaining one (Silchar) in Assam. Eleven of these observatories are maintained entirely by Government. The remaining one, Demagiri, was established and is supported by the Deputy Commissioner of the Chittagong Hill Tracts. The following table gives the list of the third-class observatories, with the names of the superintendents and observers during the past year :—

Third Class Stations.

Stations.	Superintendents.	Observers.	Observers' allowance.
Darjeeling ...	.....	M. J. Blong[1]	25
		E. S. Aratoon[2]	
		T. W. DeSouza[3]	
		G. R. Miller[4]	
Purneah ...	Dr. Picachy	Babu Gunga Narain Roy[5]	15
		„ Brojo Nath Sanial[6]	
		„ Russick Lall Basu[7]	
Durbhanga ...	„ R. G. Mathews[8]	„ Jogin Chandra Banerjee.	
	„ R. C. Sen[9]		
	„ T. C. Shaw[10]		
Gya ...	„ R. McLeod	Nowrungee Lall	15
Berhampore ...	„ S. M. Shircore	Babu Mahendra Nath Roy	15
Burdwan ...	„ W. F. Murray, M.B.[11]	„ Mokhoda Prosad Chowdry[15] ...	15
	„ Denobundhoo Dutt[12]	„ Makhan Lall Chowdry[16] ...	
	„ R. Bird, M.D.[13]		
	„ H. B. Purves, M.D.[14]		
Jessore ...	„ Gordon Price[17]	„ Paresh Nath Roy Chowdry ...	15
	„ Tarok Nath Ganguly[18] ...		
	„ A. Barclay[19]		
Dacca ...	.....	Mr. E. W. Shave	25
Silchar ...	„ J. J. Monteath	Babu Ramesh Chandra Bhadra ...	15
Demagiri ...	.....	Debendra Nath Guho.[20]	
		Kunja Behary Nandy.[21]	
False Point ...	.....	Mr. G. S. Adshead	30
Akyab ...	.....	„ J. M. Bennett...	25

[1] To 15th April 1880.
[2] From 16th to 30th April 1880.
[3] From 1st May to 19th December 1880, and since 19th January 1881.
[4] From 10th December 1880 to 18th January 1881.
[5] To 31st December 1880.
[6] From 1st January to 28th February 1881
[7] Since 1st March 1881.
[8] To 9th May 1880.
[9] From 10th May to 19th October 1880.
[10] Since 20th October 1880.
[11] To 5th November 1880.
[12] From 6th to 8th November 1880 and 27th December 1880 to 15th February 1881, and since 23rd March 1881.
[13] From 9th November to 26th December 1880.
[14] From 16th February to 22nd March 1881.
[15] From 15th June 1880 to 3rd March 1881, and since 11th March 1881.
[16] To 14th June 1880, and from 4th to 10th March 1881.
[17] To 12th September 1880.
[18] From 13th September to 20th November 1880.
[19] Since 21st November 1880.
[20] To 20th December 1880.
[21] Since 21st December 1880.

No change has been made in the working, or character of the observations taken at these stations. They are all, I have reason to believe, from the intercomparison of the observations furnished by them, in a satisfactory state, and continue to furnish fairly accurate and reliable observations. The Berhampore, Burdwan, Dacca, False Point, and Akyab observatories are the most satisfactory. The observers at these stations are not only intelligent, but take a real and hearty interest in their work, and send in their returns carefully and neatly drawn up, and with creditable punctuality.

Rain-recording Stations.—These are 161 in number and include the great majority of the revenue stations. The rainfall returns are made up and forwarded weekly, and are generally sent in with punctuality; and thus enable me to publish the monthly return of rainfall in the *Gazette* on the third or fourth week of the ensuing month.

Inspection of Observatories.—A larger proportion than usual of the stations were inspected during the past year. Mr. Blanford, in his cold-weather tour, visited Chittagong and Akyab *en route* to Burmah. I was able to inspect Hazaribagh, Patna, False Point, Cuttack, Berhampore, and Darjeeling. The Hazaribagh Observatory I found to be in thoroughly good order. The shed is excellently situated in an open site; and near it, on the highest ground in the neighbourhood, is placed the anemograph tower. The anemograph (a Casella) had been in operation for about eight months when I visited the observatory. As it worked a little stiffly, it was taken to pieces and cleaned from rust and oiled. The observer was also instructed in the method of taking it to pieces and cleaning it. He will in future, I am confident, keep it in continuous effective working order.

The Cuttack observatory is situated in the compound of the Telegraph office, and although in not quite so open a position as the Hazaribagh observatory, its position and exposure are as good as those of the great majority of our Indian observatories, situated, as they are, in towns in which trees form so large and important a feature. The anemograph (a Casella) is placed on the roof of the Telegraph office, and was in capital order. The telegraph master takes a very intelligent interest in his meteorological work, and is one of the best of my observers. The instruments were all thoroughly clean, the observations very neatly kept, and the anemograph in thoroughly good order. A comparison was made between the anemograph and the anemometer formerly in use for recording the velocity of the wind, and the two were found to give results agreeing much more closely than I expected. The large anemographs always give a less velocity than the small anemometers in use in the Indian Meteorological Department. In the case of Cuttack, however, the differences between the readings of the two instruments were less than in any other similar comparison which I have yet made.

Bankipore was visited, in order to decide whether it would be advisable to remove the observatory to the compound of the Temple School of Medicine. The observer has recently been appointed head clerk in the office of the Principal of the Temple School of Medicine, and lives in a house in the compound of the school. As the present position of the observatory is about a mile and a half from his house and office, his additional duties render it very difficult for him to attend to his observatory with the punctuality required by the Department; and hence, it was necessary to decide, whether it would be best to retain the present observer's services, by removing the observatory to the site proposed by the Superintendent, or to make fresh arrangements for the work of observation. I examined the two sites, and came to the conclusion that the exposure and situation of the present and proposed sites are very similar, and that the new site will have the advantage of giving much greater protection to the instruments than hitherto. The old site was on an open maidan, and the instruments were liable to breakage by mischievous children, straggling cows, &c. The present observer voluntarily offered, with the assistance of the second observer, to take a double set of readings during the present year, one at each place, in order to enable the past observations taken at the old site to be compared in future with those taken at the new site. A small sum of Rs. 20 enabled him to adapt a small thatched building in the compound for the reception of the instruments. If the comparison of the two sets of observations, at the end of the year, indicate similarity of exposure and of position, I shall then propose the transfer of the observatory to the new site selected for it in the compound of the Temple School of Medicine; and at which tentative observations are at present being taken.

The Bankipore Observatory I found to be generally in good order. The only instrument which was not working satisfactorily was the anemometer. It was out of order, owing to occasional slipping of the teeth; and was, moreover, very badly fixed on a long and loosely attached wooden post, which oscillated considerably during moderately high winds. A new instrument was sent, which has been rigidly fixed in accordance with the instructions I left with the observer.

In consequence of the proposed changes at Bankipore, the house for the anemograph, the erection of which was sanctioned some time ago, has not yet been commenced; and I meanwhile proposed that it should be sent to Darjeeling and utilised there for continuous observations of the wind at a hill station. As the Meteorological Reporter to the Government of India has approved of the suggestion, I hope to be able to carry it out during the present year.

False Point Observatory I visited *en route* to Cuttack. It is situated on an open site near the Telegraph office at Jumboo. Orders have been given for the erection of a second Telegraph office at False Point, on a site close to the Port Officer's house and dâk bungalow. I was informed, when at False Point, that the Telegraph office at Jumboo will not be closed, and in that case I think it would not be advisable, as it was originally proposed, to remove the observatory to the new Telegraph office The instruments were in good order. As the shed was in a very shaky condition, repairs having been delayed owing to the doubt whether it would be necessary or desirable to remove the observatory at an early date to the new Telegraph office, I gave instructions to have it put into a satisfactory state. The repairs have been effected, and the observatory is now in good working condition, and is in the hands of a trustworthy and intelligent observer.

The Berhampore Observatory had not been visited for some years. It is placed on an open maidan, at a short distance from the river and from the Civil Surgeon's office. The shed is a very small one, and is hardly suited to the present state of the work of observation in Bengal. I think it will be desirable, if funds allow it, to reconstruct it on the same site and in accordance with the standard plan adopted for Indian observatories sketched in the *Vade Mecum*. The observer is very intelligent and accurate, and I found the instruments in very good order. The anemometer, as at Bankipore, was not rigidly fixed, and hence swayed about to a considerable extent during high winds. The wind returns of the past two years at least hence probably give wind velocities and averages slightly in defect of their true values.

I inspected the Darjeeling Observatory, with the intention of placing it on a more satisfactory footing, and, if possible, in a more suitable site than it at present occupies. As I pointed out in my last report, it occupies a very narrow and confined space, between the Telegraph office and an adjacent bungalow, the conditions of exposure being almost as unsatisfactory as they could be. The small space allotted to the observatory was, I found, being encroached upon by the addition of a small covered verandah to the Telegraph office. As the observatory, in its present position, is utterly unsuited for either temperature, wind, or rain observations, I selected two suitable sites—the one on Observatory Hill at some little distance from the Telegraph office, and the other in the grounds of St. Paul's School. I endeavoured to arrange for the working of the observatory on Observatory Hill by means of the present observer, the telegraph master; but he pointed out that it would be impossible for him to arrange for taking observations at so great a distance from his office. I have therefore been compelled to adopt the site in the grounds of St. Paul's School, as the only suitable site for a permanent observatory. The Rector has kindly promised to give every assistance, and will arrange for the recording of the observations by one of the assistant masters in the school. I hope therefore, during the present year, to arrange for the removal of the Darjeeling Observatory to the new site in the grounds of the St. Paul's School, and also for the erection of a suitable house for the anemograph, which I have proposed to transfer from Patna. By these changes, Darjeeling will become one of the most important of our observing stations, and will give information respecting the upper currents of the atmosphere, which may be exceedingly valuable.

Mr. Blanford found several defects of exposure of the instruments at the Chittagong Observatory, which he rectified. Akyab he found to be in thoroughly good order.

I may add that there is hardly any excuse whatever for any defects in the arrangement of observatories, or of exposure or conditions of the instruments, as the *Vade Mecum* issued to all superintendents and observers gives full and precise information on every matter that is likely to arise in the management of an observatory, or the care of meteorological instruments. And it is a matter to be regretted that superintendents and observers, more especially of the third-class observatories, fail to make the use of the *Vade Mecum* that they ought to do, and allow defects, carefully pointed out and guarded against by suitable instructions in that work, to creep in; which impair the value of the observations, and which, in many cases, are not detected until the next inspection of the local Meteorological Reporter.

Central Office.—The office staff of the Bengal Meteorological Department consists of the following:—

Names.	Rank.	Salaries. Rs. A. P.
Babu Fanindra Mohan Basu	Head Clerk in charge	.....
„ Poorna Chunder Mookerjee	2nd Clerk	34 0 0
„ Kaminy Mohun Basu	3rd do.	24 0 0
„ Narendra Nath Mazoomdar	Tabulator	25 0 0
„ Jogeshur Roy	Ditto	17 0 0
„ Debendra Nath Banerjee	Ditto	16 0 0
„ Banikant Roy Chowdhry	Ditto	16 0 0

The regular and systematic work of the office consists in the reduction of the observations of the Bengal and Assam stations, and their tabulation in the prescribed forms for the preparation of the various returns of the Bengal and Indian Meteorological Reporters. The Bengal Office has prepared and published the following returns during the year in the *Calcutta Gazette*:—

1. A monthly summary, giving the averages or totals of the observations taken at the twenty observing stations in Bengal and Assam.
2. A monthly return of the rainfall, giving the rainfall of each day of the month and a comparison of the total rainfall of the month with the averages of previous years.

Storm-signals.—The hoisting of the storm-signals during the past six years has been performed in accordance with instructions issued by the Bengal Government, 20th November 1874, and published in the *Calcutta Gazette*. They are hoisted whenever bad weather is probably prevalent in the Bay, and in such a manner as, if necessary, to give, in continuation of the bad weather signals, information, first of the probable formation of a cyclonic vortex in the Bay, and afterwards of its probable approach to the mouth of the Hooghly. These signals are consequently used for two kinds of storms, both cyclonic, but differing very considerably in violence and destructive effects. The one class includes the comparatively rare and severe cyclones of the transition periods of May and October, usually accompanied with a storm-wave, the magnitude of which is closely related to the intensity and magnitude of the storm. The second class includes the smaller cyclonic storms that are frequent during the whole period of the rains. They generally originate during partial breaks in the rains over Northern India, and bring up heavy rain to the coast and adjoining districts which they pass over in their path, before they are broken up. These storms are generally much less severe, and of small dimensions compared with the cyclones of the previous class, and are rarely, if ever, associated with a storm-wave. Whether some distinction between the warnings hoisted might not be employed to intimate the general character of the approaching storms to pilots and captains of vessels, is a question which will probably require early consideration.

The "bad weather" signals only were hoisted three times during the past year. The storm on each occasion, although cyclonic, was small in extent and of no great intensity, as measured by the barometric depression at the centre. They were all what may be termed south-west monsoon storms, and hence the warning and danger signals were not hoisted in addition to the bad weather signal. The

three occasions on which they were hoisted at Saugor Island, Diamond Harbour, and Mud Point were—

a. 2nd June for about 25 hours,
b. 22nd September for about 21 hours,
c. 14th October for about 26 hours.

Daily Weather Reports.—The scheme for the extension of the storm-signal service, and for the preparation of a daily report and chart for the use of the Calcutta public, described in my last report and sanctioned by the Government of Bengal in March 1880, came into operation on 1st April 1880. For the first six weeks the charts and reports were printed by means of chromographs, and afterwards by a lithographic press lent by the Surveyor General. Several of the original subscribers withdrew their names. The report was distributed during April 1880 to 23 paying subscribers. During the rains several additional copies were subscribed for; but during the cold weather, when the atmospheric conditions of the Bay are generally remarkably uniform, quiet, and uninteresting, three or four subscribers withdrew their names. At present there are 27 paying subscribers. The amount received monthly, (averaging Rs. 57 during the past year) has not only sufficed to pay the cost of the additional establishment, (pressman and two assistants and peons to deliver the reports), but also to leave a small balance, which has been credited to Government. In addition to the copies issued to subscribers, eighteen additional copies are supplied to various Government offices and officials, all of whom are more or less directly interested in the character of the weather at the head of the Bay. The extension of the signal service, and the publication of the daily report and chart, has thus been as successful as I had anticipated, and will, I hope, continue to form an important and valuable part of the work of the Bengal Meteorological Department.

Maritime Meteorology.—The Government of India, last year, sanctioned a small scheme for the commencement of this work. Less has been done, I regret to state, than I expected. This was partly due to temporary additional work as Professor in the Education Department, and partly to my absence from India on privilege leave. One of the two clerks sanctioned by the Government o India has been employed, during the greater part of the past year, in arranging and tabulating the information given in the Books containing the observations in the Indian seas collected by the Board of Trade. Observatories have been established at Aden and Amini Divi. The former I visited during my return voyage from England in October. The Aden Observatory is favourably situated and in thoroughly good order, and is effectively superintended by Captain Hunter. Regular observations have also been obtained, during the past year, from three of the floating light vessels at the mouth of the Hooghly, *viz.*, from the *Canopus*, *Comet*, and *Mermaid*. I have also received, during the year, meteorological extracts from a number of vessels entering the port, sent to me either by the captains of the vessels, or obtained for me by S. R. Elson, Esq., Master Pilot. Nothing has as yet been done towards collecting accurate observations in the Indian seas by means similar to those adopted by the Board of Trade at home. There are many difficulties to be overcome, before a voluntary system, such as that adopted by the Board of Trade, can be effectively established; and in India, especially, these difficulties are increased by the not unfrequent office changes, by the limited amount of time at my disposal for meteorological work, and finally by the great difficulty in obtaining adequate funds for the establishment and extension of a purely scientific department, such as that devoted to maritime meteorology must necessarily be. The intimate dependence of the land meteorology in India on the meteorology of the adjacent seas, and the vast importance of the study of the great south-west monsoon current, in its whole circulation both over the ocean and over the land will, I feel confident, be sooner or later recognised, and then this integral portion of our Indian meteorological work will be established on a basis equal to its importance.

APPENDIX B.

Extracts from the Administration Report of the Meteorological Reporter to Government, North-Western Provinces and Oudh, for the year 1880-81.

Observatories.—The number of meteorological stations sending returns to my office has been considerably increased during the past year. Observatories on the voluntary system were established at Nowgong, in Bundelkhand, and at Sambhar, in Rajputana, some time ago; the former more than four years ago. The observations made at these stations were at first sent to the Calcutta Meteorological Office, where they were reduced and published in the annual reports on the meteorology of India, but from the commencement of the present civil year they have been sent for reduction and publication to the Allahabad office. Under the new arrangement the results are published in the local *Government Gazette* within one or two months of the time when the observations were taken, and the returns from these two stations can be readily compared with those of the neighbouring stations of Jhánsi and Ajmere, which have always been filed in the Allahabad office.

At the beginning of January, a new meteorological observatory was established at Jeypore, in Rajputana, and maintained at the cost of the Government of that State. This station is organised as a second-class one, at which observations are taken at 10 P. M. and 4 A. M. every day, as well as at the corresponding hours in the day time. Hourly observations are also taken on four days in each month, and synoptic observations for the American International Weather Charts have been commenced from the 1st April. Arrangements are also in progress for taking observations of underground temperatures; and a self-acting anemograph, constructed under the personal superintendence of Mr. Osler, has been erected to register the movement, pressure, and direction of the wind. The observatory is superintended by Dr. T. H. Hendley, Agency Surgeon, who takes an active interest in meteorology, and has for the past seven years kept a careful register of temperature, wind, and rainfall at his house, which adjoins the new observatory.

Two voluntary stations have been established during the year, in the Himalayas, the chief object of opening them being to get an accurate record of the winter snowfall. One of these is at Pithoragarh, near the Nepal frontier, and the other at Pauri, in Garhwal, nearly midway between Naini Tal and Mussooree. The observer, at Pithoragarh, is the Revd. Dr. R. Gray of the American Methodist Mission, and at Pauri the permanent observer will be the Revd. J. H. Gill, a former observer for the United States Weather Department. Just now Mr. Gill is absent on furlough, and the observations are taken by his *locum tenens*, the Revd. J. T. McMahon. The instruments sent to these stations had arrived, and the thermometer sheds intended for their reception were nearly finished at the middle of March, but no observations were taken at them during the year under report.

The Allahabad Observatory is still maintained under the temporary make-shift arrangement, which, for want of a better, was adopted in 1874. The accommodation for the meteorological office and a first-class observatory, promised by the Local Government in 1875, is still unprovided, and the Van Rysselberghe meteorograph, intended for Allahabad, remains for the present in Calcutta.

In last year's report, it was stated that the Provincial Government had promised to provide accommodation for the meteorological office at the new Muir College; but on inquiry being made, this year, whether there was any room to spare in the College buildings, it was found that the building was too small even for its original purpose. Proposals have now gone up for the addition of another wing to the College, and if these are sanctioned, the necessary accommodation will probably be provided in about two years more. It will be two years, most likely, before the building is finished, and the grounds near it are cleared sufficiently of stones and rubbish to furnish a proper site for a meteorological observatory.

The stations at present reporting to my office may be classified as follows :—

	First-class.	Second-class.	Third-class.
A. Directly under the Meteorological Department.	Allahabad (in abeyance).	Allahabad (temporary).	Chakrata.
		Lucknow	Ranikhet.
		Agra	Bareilly.
		Roorkee	Gorakhpur.
			Benares.
			Sutna.
			Jhánsi.
			Ajmere.
B. Voluntary and independent.		Jeypore[1]	Derah[2].
			Meerut.[2]
			Nowgong.[4]
			Sambhar.[4]
			Pauri.[4]
			Pithoragarh.[4]

A list of the superintendents and observers who have acted during the year will be found in Table I.

Inspection of observatories.—During my hot-weather tour, I inspected the observatories at Lucknow, Bareilly, and Ranikhet, and in December and January I visited Agra, Ajmere, Sambhar, Jeypore, Jhánsi, Nowgong, Benares, and Gorakhpur. In March, I paid a short visit to Sutna. At all these stations, the instruments were found, as a rule, clean and in good order, and the observers, most of whom have now been at work for several years, seemed to understand thoroughly the working of the ordinary instruments. The observatory sheds were all maintained in good repair. Mr. Blanford visited Lucknow in November, and, I believe, found everything in excellent order, except the anemograph.

Verification of Instruments.—At every station I visited, except those where the thermometers had been recently verified, I tested the thermometers in use by placing them in water along with a Kew standard, the error of which at each point of the scale is known. All the thermometers that had been in use for three or four years were found to read somewhat too high, when the corrections furnished with them were applied; but the error did not, in any case, exceed half a degree, and may have been partly due to the fact that the standard thermometer with which the instruments were previously compared in Calcutta read a little too high.

The barometer, at each station, was also compared with one or two travelling barometers. The results of these comparisons were not so satisfactory as those of the thermometer verifications. The barometers in use at Ajmere and Sutna were found to have a little air in the tube, and their readings had thus been slightly erroneous, for an unknown time before my visit. A correction in each case was obtained for the error at the time when the station was inspected, and the barometer was replaced as soon as possible by a new one. At most of the other stations the difference between the index error of the barometer determined by comparison with the travelling standard and that previously determined did not exceed ·004″ or ·005″, that is to say, it was less than the probable error of the result of a short comparison

[1] Under the Maharaja.
[2] Under the Survey of India.
[3] Under the Municipality.
[4] Observers unpaid.

made in the ordinary way. At Lucknow, where the error of the corrected readings of the barometer in October 1879 was found to be ·009″, a further comparison with two travelling standards, last May, gave no error at all, and a short comparison made by Mr. Blanford in November 1880 gave an error of ·002″.

The result of the barometer comparison at one of the stations visited this year, was somewhat startling, and has not yet been thoroughly explained. At Gorakhpur the barometer, which was furnished with a capacity correction determined by Mr. Blanford in 1876, was found to read ·040″ too low at the "neutral point," where it was assumed to read exactly right. This instrument having been in use almost from the commencement of the series of observations at Gorakhpur, the difference between the mean of any month and the mean for the same month in other years gave no indication of such an error. The instrument, which has probably lost some mercury by leakage since it was first compared, has now been recalled, and will again be tested by comparison with the standard in Calcutta.

Probable error of the assigned elevation of certain stations.—For several years the readings of the Jhánsi barometer, reduced to sea-level, have been invariably lower than those of the neighbouring station of Nowgong, and this notwithstanding changes of instrument both at Jhánsi and at Nowgong. No error could be found in the barometers in use when I visited the stations, to account for the difference then existing; and it seemed, therefore, probable, that the assigned elevation of Jhánsi above sea-level was too low, or that of Nowgong too high. Both of these elevations had been determined by spirit-levelling from G. T. S. bench-marks, but the elevation of Nowgong had been ascertained more recently than that of Jhánsi, and the bench-mark from which it was measured was much nearer. The Commissioner of Jhánsi was, therefore, asked to get the elevation of the Jhánsi barometer redetermined by the Public Works Department officers in his division. This was done by levelling to one of the Bundelkhand irrigation bench-marks, with the result that the previously assigned elevation was 4·4 feet too great, instead of being too little, as was supposed. It seems from the observations that there is either a very curious permanent barometric depression about Jhánsi, or that some of the Bundelkhand levels are at least 10 feet in error. The Superintendent of the Nowgong Observatory has been asked to have the elevation of his barometer above sea-level ascertained by levelling to another bench-mark if possible. [1]

Special Instruments.—The anemograph, at Roorkee, worked well throughout the year, and that at Lucknow fairly well; but the velocities indicated by the latter instrument were very low, and there was apparently an undue excess of northerly winds shown by the traces. Mr. Blanford, who visited the station in November, attributes these defects to the position of the instrument near the southern edge of a large flat roof, round which runs a parapet nearly as high as the cups and vanes which are moved by the wind. He recommended the removal of the anemograph to a detached and somewhat higher building, but this removal had not been carried out at the end of the year. A special building had to be erected for the anemograph sent to Sutna, and mentioned in last year's report. This is now finished, and it is hoped that during the current year a valuable series of traces will be obtained from Sutna.

The simple barograph set up at Allahabad as an experiment in February 1880 has continued to work satisfactorily. So much cannot be said for one of Negretti and Zambra's patent self-registering thermometric apparatus, sent up from Calcutta for trial during the year under report. In this, a sliding bar, moved by a clock, is supposed to upset one of Negretti's patent thermometers every hour, and thus register the temperature at each hour. The workmanship of the thermometers is most excellent, but the brass frames in which they are mounted have so much play on both sides of the proper position that they are sometimes overturned half an hour too soon and sometimes half an hour too late. The instrument has therefore never been brought into practical use.

At the beginning of May, a set of thermometers, giving the temperature of the soil at the surface, at 1 foot deep, and at 3 feet deep, were brought into use at Allahabad, and the temperatures at these depths have been observed regularly four times every day. The means of eleven

[1] It has been found to be 12·65 feet lower than as originally reported, *viz.*, 757·04′

months' readings, which will be found in Table II, indicate that the temperature of the ground is four or five degrees higher than that of the air, and that the diurnal range, which is very great at the surface, almost disappears at a depth of 3 feet.

A nephescope, to show the direction of movement of the upper clouds, was also erected in May, and has been found very useful.

Character of the Observations.—The observations generally, have been taken, I believe, with great care. The daily transmission of the 10 A.M. observations by post or telegraph to the office of the Meteorological Reporter to Government of India, where they are compared with one another in drawing up the daily weather reports, at once brings out any error or omission on the part of the observer. When an error is discovered, a note of it is sent to the superintendent of the observatory, and the observer is called upon to correct or explain it. The only station where this had to be done more than twice or three times during the year was Gorakhpur, where for several days in succession the observer inadvertently omitted to enter the date on which observations were taken. It is doubtful whether the observations are all taken with the punctuality as regards time that should be observed, if they are to be perfectly trustworthy. During my cold-weather tour, I made the discovery that at all the stations on the railway, Madras (or railway) time was kept instead of local time. I had previously assumed that all the observers and superintendents were perfectly aware that the diurnal variations of the several meteorological elements are controlled by the daily march of the sun in his apparent path at the place of observation, and not at Madras. Even without knowing the reason why they should do so, the observers would have kept local time if they had attended to the instructions expressly laid down in the manual compiled for their guidance. The difference between Madras and local time does not exceed 10 or 12 minutes at any of the stations which report to me, except those in Rajputana, where it varies from 20 to 24 minutes. Since the 1st January, the observers have been instructed to regulate their clocks by railway time, since that is most convenient for ordinary purposes, and to take the observations either before or after the hours as indicated by the clock, at a constant interval equal to the difference of longitude.

The observers at the second-class stations, Roorkee, Agra, and Lucknow, who, previous to 1875, were drawing a higher rate of pay than they do now, because they were then required to take observations at 10 P.M. and 4 A.M., which have since been discontinued, sent up a petition, approved by the superintendents of the three observatories, asking to have the former rate of pay restored. The question raised is one for settlement by the Meteorological Reporter to Government of India, as it involves the general question whether observers after long and approved service are to get any increase of pay or not. The petition has accordingly been transferred to him, with the recommendation that something should be done to content the observers, who, on the whole, work very well, and whose duties, when everything is counted, are now nearly as onerous as they were in 1874.

Office and Office Work.—The strength of my office has been permanently increased by the appointment of the man, temporarily employed last year, to assist in working up arrears. In consequence, the current work of the office was kept well up to date, and some little extra work could be undertaken; but with the increase to the number of stations since the 1st January, it is doubtful whether the staff will suffice for future requirements. At the same time that the new clerk was appointed the head clerk got a well-deserved increase of pay.

The observations taken at Allahabad have been published daily in the local newspapers. A monthly abstract of the results of observations at all the stations, drawn up after the preparation of the permanent registers, has been published in the *North-Western Provinces and Oudh Government Gazette*, generally before the end of the month succeeding that in which the observations were taken. Copies of the monthly registers for each station have been prepared and sent to the Calcutta office.

A weekly abstract of the rainfall, recorded at numerous stations in the North-Western Provinces and Oudh, has been regularly published in the local *Gazette;* and a table giving the monthly totals at each station for 1880, the number of rainy days in each month, and the average monthly rainfall of each place, has also been published. From a comparison of the figures recorded at the meteorological observatories and at the adjacent revenue stations, it seems that the returns from some of the

latter are from 10 to 20 per cent. too low on the average of many years. These errors are to be attributed chiefly to the defects of the existing gauges, and accordingly an application has again been made to the Provincial Government for the provision of accurate gauges.

The paper on the meteorology of Allahabad, mentioned in last year's report, is now going through the press. A chapter on the meteorology of the North-west Himalaya has been written for the "Hill Districts" volume of the *North-Western Provinces Gazetteer*, and will be reprinted in the *Meteorological Memoirs*.

ALLAHABAD,
The 5th April,

S. A. HILL, B. Sc.,
Meteorological Reporter to Govt N.-W. Provinces and Oudh.

I.—Names of the Observers and Superintendents of the several Observatories in the North-Western Provinces, Oudh, and Rajputana, during the year 1880-81.

	Observatory.	Observer.	Superintendent.
Second Class.	Allahabad ...	Kedar Nath Chattarji, with an assistant.	S. A. Hill, Esq.
	Agra ...	Mir Altaf Ali, with an assistant ...	Dr. A. H. Hilson. Dr. E. A. Fitzgerald.
	Jeypore ...	Durga Prasad, Ganga Din ...	Dr. T. H. Hendley.
	Lucknow ...	Chotay Lal, with an assistant ...	Dr. B. Franklin. Dr. J. C. Whishaw.
	Roorkee ...	Chiranji Lal, with an assistant ...	Dr. Murray Thompson.
Third Class.	Chakrata ...	Salig Ram ...	P. Mackenzie, Esq., C.E.
	Ranikhet ...	Jewanand ...	No Superintendent.
	Dehra ...	The head computers ...	J. B. N. Hennessey, Esq., F.R.S.
	Meerut ...	Har Saran Das ...	Dr. W. Moir.
	Bareilly ...	Jwala Prasad ...	E. A. Phillips, Esq. P. Kennedy, Esq.
	Gorakhpur ...	Sheo Lochan ...	Dr. C. Prentis.
	Benares ...	Devakinandan Patak ...	G. Thibaut, Esq., Ph.D.
	Jhansi ...	Kalka Das ...	Dr. C. L. Swaine. Dr. G. M. Nixon.
	Ajmere ...	Ram Prasad[1] ...	Dr. J. H. Newman.
	Sutna ...	Har Nath ...	Dr. S. J. Goldsmith. Dr. Abdur Razzak.
	Sambhar ...	Janaki Nath Sanyal, to 15-5-80 ...	W. Lyon, Esq.
		Mohesh Chandra Haldar, to 13-6-80	W. Synnot, Esq.
		Mr. John Romare, to 31-3-81 ...	W. Foster, Esq.
	Nowgong ...	J. Mather[2] ...	J. Mather, Esq.
		Karim Bakhsh[3] ...	

1 Was absent from duty from 20th April to 28th May 1880, the observations being carried on by a substitute.
2 From 1st April to 12th September 1880.
3 From 13th September 1880 to 31st March 1881.

II.—Results of Ground Temperature Observations.

Month.	Surface.				One foot deep.				Three feet deep.				Mean Temperature.				Remarks.
	4h.	10h.	16h.	22h.	4h.	10h.	16h.	22h.	4h.	10h.	16h.	22h.	Air in shade.	Ground surface.	One foot deep.	Three feet deep.	
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	
May 1880 ...	82·8	112·1	110·3	90·9	94·0	93·1	95·1	96·3	89·5	89·4	89·0	89·6	91·5	99·1	94·6	89·4	
June „ ...	87·5	111·5	108·9	93·6	96·5	95·8	97·5	98·1	92·8	92·8	92·8	92·9	94·3	100·4	97·0	92·8	
July „ ...	81·2	90·4	90·1	83·2	87·5	86·9	88·0	88·2	88·8	88·8	88·6	88·6	83·3	86·2	87·7	88·7	
August „ ...	82·4	91·0	92·4	85·1	87·1	86·6	87·6	88·0	86·9	87·0	87·0	86·9	84·5	87·7	87·3	87·0	
September „ ...	80·4	92·0	91·7	83·1	86·4	85·8	87·6	87·4	87·0	87·2	86·8	86·9	83·0	86·8	86·8	87·0	
October „ ...	74·0	99·0	98·6	78·6	84·0	83·7	86·9	85·5	85·9	86·0	86·1	85·9	80·7	87·5	84·8	86·0	
November „ ...	59·5	83·3	84·5	65·0	72·7	72·6	74·4	74·4	79·8	79·9	80·0	79·8	67·7	73·1	73·5	79·9	
December „ ...	51·6	71·2	77·1	57·2	64·0	63·5	65·4	65·8	71·8	71·9	72·1	71·9	60·1	64·4	64·7	72·0	
January 1881 ...	48·3	70·1	79·3	55·6	62·1	61·5	63·3	64·5	68·6	68·7	68·9	68·9	59·1	63·4	62·9	68·8	
February „ ...	58·7	82·2	89·6	66·7	70·4	69·7	71·2	72·8	71·7	71·8	72·0	72·0	69·4	74·3	71·0	71·9	
March „ ...	65·4	88·7	93·9	73·1	77·1	76·5	78·2	79·5	77·3	77·4	77·5	77·5	74·9	80·3	77·8	77·4	

APPENDIX C.

Administration Report of the Meteorological Reporter to the Government of the Punjab for the year 1880-81.

During the year under report, no change has been made in the number of observatories sending returns to this office. The only change in the work has been a slight alteration in the hour of registration of the synoptic observations at Lahore, which has been altered from 17·40 to 17·5, equivalent to 7 A. M. Washington time. Twelve observatories submit weekly and monthly registers to this office, of which two are second and ten third class. The registers are revised and corrections applied at Lahore, and transmitted after computation of humidity, vapour tension,[1] &c., to the Meteorological Office in Calcutta once a month.

2. The Lahore Observatory is a second-class observatory and registers five sets of daily observations, and hourly observations four times a month. The other second-class observatory, at Leh, is worked in accordance with the rules in force in the Indian Observatories generally.

3. The third-class stations in the Punjab are Mooltan, Dera Ismail Khan, Sirsa, Delhi, Peshawar, Murree, Rawalpindi, Sialkot, Ludhiana, and Simla. Simla has only been placed regularly under this office since April 1880; previous to that time it had been under the Quarter Master General's Department, and the observations were not trustworthy, nor were they continuous, for none were taken on Sundays and holidays.

4. During the year I inspected the observatories at Mooltan, Rawalpindi, Murree, Sialkot, Ludhiana, and Simla, and made arrangements for the systematic inspection of all the observatories in future. My tour of inspection during the school vacation would have been fairly complete in 1880, but for a question which arose as to whether the observatories were to be inspected by me or not. The Punjab Government decided that the Meteorological Reporter should make a systematic inspection of all

[1] The computation of the vapour tensions has hitherto been left to the office of the Meteorological Reporter for India.—H. F. B.

the observatories once a year, but in the meantime my work at the Medical School had recommenced, and the orders of Government could not be carried out till this year, 1881.

Character of the work.—The work has, on the whole, been performed with care on the part of the observers. Last year I had to complain of some of the observers handing over their duties to subordinates; but from the 1st of January 1880, every register sent to this office has been accompanied by a declaration that all observations recorded were taken by the observer himself, and this has I, believe, led to greater accuracy in the character of the observations. I am not at all satisfied, however, that they have been taken with absolute punctuality to time.

The comparison of observations in the office of the Meteorological Reporter to the Government of India led to the discovery that strict local time was not kept during a considerable period of 1880 at Lahore. This error was due to the time at the observatory being taken from the station gun, which is very irregular, and not direct from the railway. Since the mistake was brought to my notice, all the observers have been reminded of the instructions issued when I first took charge of the office, *viz.*, to regulate their clocks by railway time, which is Madras time, and take the observations at the regular interval after the hour indicated by the clock, corresponding to the differences in longitude between Madras and their stations.

During my inspection tour I found that good clocks were required at all the stations I visited.

A representation to this effect led to the supply of clocks for all the observatories, and watches for the observers at the second-class stations. As regards instruments, I found them as a rule in good order, but at Mooltan and Ludhiana the barometer was improperly hung and the instruments bore evidence of having been hurriedly cleaned up in anticipation of my visit. At Rawalpindi, the observer did not understand the working of the instruments, and had sent in no telegraphic reports for a month previous to my inspection. All the observatories were kept in good repair throughout the year.

A list of the superintendents and observers who have had charge at the different observatories throughout the year is appended.

The routine work of the office has been conducted as usual; the correspondence has increased very considerably; and, during the year, monthly meteorological abstracts were prepared for the Sanitary Commissioner of the Punjab, as well as a special climatological statement for the Punjab Government.

This statement will in future take the form of regular report, in accordance with the orders of Government.

The Lahore Observatory is still a second-class observatory, and the office accommodation is so limited and inconvenient that a great portion of the work has to be done in my own house.

The Punjab Government promised better accommodation for the office, and a first-class observatory has been in contemplation since the year 1876. The building of the new Medical School, a portion of which is designed for the Meteorological Department, has commenced and will probably be finished this year, when the accommodation so urgently required will be obtained.

It is to be hoped that a first-class observatory will follow, as the present shed is in a faulty position, and was never intended for more than a temporary arrangement.

E. A. LAWRIE, M.B.,
Meteorological Reporter to the Govt. of the Punjab.

List showing the names of the Superintendents and Observers in charge of the Meteorological Observatories in Punjab during the year 1880-81.

Observatories.	Class.	Names of Superintendents.	Period. From	Period. To	Observers.	Period. From	Period. To
Lahore	II	Dr. Edward Lawrie, M.B., Meteorological Reporter.	Throughout the year.		Babu Jasput Rai, Head Clerk Meteorological Office.	Throughout the year.	
					Babu Divan Chand, 2nd Clerk ...		
					Babu Bhagwan Dass ...	„	„
Ludhiana ...	III	Dr. Rouse, Civil Surgeon ...	„	„	1 Assistant Surgeon Radha Kishen	1st April ...	28th April.
		1 Surgeon M. J. Fairweather ...	1st April ...	10th April ...	2 „ „ Ram Kishen	29th „ ...	17th November.
		2 Assistant Surgeon Radha Kishen.	11th „ ...	19th „ ...			
Dehli	III	3 J. Furguson, Civil Surgeon ...	20th „ ...	7th June ...	3 „ „ Gokul Chand	18th November	22nd March.
		4 G. C. Ross, Civil Surgeon ...	8th June ...	17th March ...	4 „ „ Ram Kishen	23rd March ...	31st „
		5 A. Taylor, Civil Surgeon ...	18th March ...	31st „ ...			
Simla	III	Lieutenant-Colonel H. A. Little	1st April ...	1st November ...	Sergeant King	1st April ...	16th February.
		„ „ Lockart ...	2nd November ...	31st March ...	Corporal Peart, R.E. ...	17th February	31st March.
Sialkot	III	Dr. Martin Gaisford ...	1st April ...	25th September ...	Assistant Surgeon Fatteh Singh	1st April ...	2nd August.
		„ Thomas S. Veace ...	26th September ...	30th November ...	Babu Sardar Khan ...	3rd August ...	31st March.
		„ A. M. Crafts	1st December ...	31st March ...			
Rawalpindi ...	III	„ Henderson, Civil Surgeon ...	Throughout the year.		Assistant Surgeon Bhawani Dass	1st April ...	24th June.
					Head Assistant Beshan Lall ...	25th June ...	1st September.
					Assistant Surgeon Lachman Dass	2nd September	19th November.
					„ Bhawane Dass	20th November	31st March.
Murree	III	Rev. Peak, Principal L.A. ...	Throughout the year.		Mr. Johnson, Apothecary ...	Throughout the year.	
Peshawar ...	III	Surgeon-Major A. Taylor ...	1st April ...	13th March	Head Assistant Kashi Ram ...	1st April ...	24th February.
		„ „ T. E. L. Bate ...	14th March ...	31st „	„ „ Abdooljabbar ...	25th February ...	16th March.
					„ „ Kashi Ram ...	17th March ...	31st „
Dera Ismail Khan ...	III	Dr. R. J. Taaffe	Throughout the year.		Head Assistant Noor Buksh ...	Throughout the year.	
Sirsa	III	„ J. Rehill, Civil Surgeon ...	1st April ...	7th August ...	Hospital Assistant Fazalr Rahman,	„	„
		„ Fatteh Singh	8th August ...	31st March ...			
Mooltan	III	„ Gray, Civil Surgeon ...	1st April ...	26th September ...	Babu Vahid Ally	„	„
		„ O. Sullivan, Civil Surgeon	27th September ...	31st December ...			
		„ R. Gray, Civil Surgeon ...	1st January ...	31st March ...			
Leh	II	Mr. Ney Elias, Joint British Commissioner.	Throughout the year.		Charag Din	1st April ...	14th October.
		... ...			Sarafaraz Khan	15th October ...	31st March.
					Bola Nauth, Assistant Observer...	Throughout the year.	

LAHORE,
The 11th April 1881.

E. A. LAWRIE, M.B.,
Meteorological Reporter to the Govt. of the Punjab.

APPENDIX D.

Return showing the names of the Superintendents and Observers at the several Observatories of the Central Provinces during the year 1880-81.

Observatory.	Superintendents.	From	To	Observers.	From	To	Remarks.
Nagpur	Surgeon H. M. Leckler	1st April 1880 ...	16th April 1880 ...	Krishnaji Anant	1st April 1880 ...	21st May 1880.	
	Surgeon-Major J. F. Barter ...	17th ,, ,, ...	16th July ,, ...	T. V. Allagheriswamy ...	22nd May ,, ...	31st Mar. 1881.	
	Surgeon H. M. Leckler	17th July ,, ...	31st Mar. 1881 ...	Assistant Observer P. Soobiah ...	1st April ,, ...	31st ,, ,,	
Jubbulpore ...	Surgeon-Major W. R. Rice, M.D. ...	1st April ,, ...	31st ,, ,, ...	Baboo Prosanno Coomar Bose ...	1st ,, ,, ...	31st ,, ,,	
				Assistant Observers.			
				Hospital Asst. Koonj Bahary Lal	1st ,, ,, ...	27th Jan. ,,	
				,, Deen Mahomed ...	28th Jany. 1881 ...	13th Mar. ,,	
				,, Koonj Bahary Lal...	14th Mar. ,, ...	31st ,, ,,	
Pachmarhi... ...	Lewis Gordon, Esquire	1st April ,, ...	27th Sept. 1880 ...	Madhao Rao	1st April 1880 ...	31st ,, ,,	
	R. H. Finch, Esquire	28th Sept. ,, ...	31st Mar. 1881 ...	Asst. Observer Narain Bhagwant...	1st ,, ,, ...	31st ,, ,,	
Saugor	Surgeon-Major John William Strong ...	1st April ,, ...	31st ,, ,, ...	Deendyal Pattrick	1st ,, ,, ...	31st ,, ,,	
Hoshangabad ...	Surgeon S. H. Browne, M.D. ...	1st ,, ,, ...	31st ,, ,, ...	Jadu Nath Bose	1st ,, ,, ...	31st ,, ,,	
Khandwa	Surgeon-Major P. Cullen, M.D. ...	1st ,, ,, ...	31st ,, ,, ...	Behari Lall	1st ,, ,, ...	31st ,, ,,	
Seoni	Surgeon-Major J. B. Gaffney ...	1st ,, ,, ...	31st ,, ,, ...	Punchum	1st ,, ,, ...	31st ,, ,,	
Chanda	Mr. M. Craggs	1st ,, ,, ...	31st ,, ,, ...	Seetaram	1st ,, ,, ...	31st ,, ,,	
Sironcha	Asst. Surgn. Harran Chunder Dutt ...	1st ,, ,, ...	31st ,, ,, ...	Asst. Surgn. Harran Chunder Dutt	1st ,, ,, ...	15th June 1880.	
				P. Muthu Krishna Naidu ...	16th June ,, ...	31st Mar. 1881.	
Raipur	Surgeon-Major D. W. Trimnell ...	1st ,, ,, ...	31st ,, ,, ...	Krishna Rao	1st April ,, ...	31st ,, ,,	
Sambalpore ...	Honorary Surgeon J. E. Harrison ...	1st ,, ,, ...	31st ,, ,, ...	Babu Shamsoonder Dass ...	1st ,, ,, ...	31st ,, ,,	

APPENDIX E.

Extracts from the Administration Report of the Meteorological Reporter for Western India for the year 1880-81.

Up to the end of the year 1879-80 the operations of the Meteorological Department of Western India were almost exclusively confined to the climatological branch of the science of meteorology, but during the past year an important step has been taken towards utilizing the observations for the more immediate practical purpose of giving warning to the various ports of the approach of cyclonic storms. This step consists in the establishment of a system of daily telegraphic weather reports from seven stations on the west coast of India, and from three on the Coromandel coast, *viz.*:—

1. Karáchi.
2. Surat.
3. Ratnágiri.
4. Kárwár.
5. Mangalore.
6. Calicut.
7. Cochin.
8. Negapatam.
9. Madras.
10. Masulipatam.

The observations telegraphed are those recorded daily at the observatories at 10 A.M. The telegrams begin to arrive about 12-30 P.M., and as fast as they come in, the telegraphic code words are translated into the corresponding instrumental readings. These are corrected and reduced, and entered on a chart and also in the daily telegraphic weather report, a specimen copy of which is appended. The last telegrams usually arrive about 3 P.M., and in about an hour afterwards, a copy of the daily report is ready for despatch to the Port Officer, who posts it up at his office for inspection, and gives the information to the *Times of India* for publication in the next morning's paper. A form, giving the principal items of information, is also filled up at the Meteorological Office for daily publication in the *Bombay Gazette*.

In the event of threatening weather being reported from any of the coast stations, special telegraphic reports are called for from all the Government Observatories in the neighbourhood of the disturbance, and a special telegram is despatched to the Port Officer at Bombay, describing the observed indications. If the disturbance should threaten any of the Bombay ports, warning telegrams are at once sent to them. The following are the ports which have been selected by the Bombay Government to receive these warning telegrams, and to exhibit the storm-warning signals :—

1. Karáchi.
2. Bombay Castle.—
   A. Prince's Dock.
   B. Colaba Point.
      (*a*) Kenneri.
3. Ratnágiri.
4. Vengurla.
   A. Vengurla Rocks.
      (*a*) Malvan.
5. Kárwár.
   A. Oyster Rock Light-House.
6. Kumta.

A description of the storm signals, and the significations attached to them, will be found in Appendix II, entitled "Telegraphic Weather Intelligence." The object aimed at in this Appendix is, as far as present circumstances will permit, to secure conformity with the storm-warning system in use at home. During the past year, special telegraphic reports have been called for on two occasions, but it has been necessary to issue warning telegrams only once to the ports southward of Bombay, on the 21st November 1880, when a cyclone was crossing the southern portion of the Indian Peninsula.

OBSERVATORIES.

The number of observatories which sent in complete registers, remained the same as in the previous year, *viz.*, twenty-two; but a set of instruments has been supplied to the Port Officer at Calicut to enable him to forward daily telegraphic weather reports to this office, in connection with the new storm-warning system. If this be included, there are now twenty-three observatories working under the supervision of this office. The old observatories at Belgaum and Poona were closed during

the year, after having worked for a year along with the new ones at the same stations, so as to provide the means of connecting the old series of observations with the new. The height above sea-level of the Bickaneer Observatory has been determined during the year, and that of Ratnagiri has been verified. The list of observatories and the names of the supervising officers and of the observers are given in Appendix III.

Inspection of Observatories.

During the past year, I have inspected the observatories at Poona, Surat, Rajkot, Deesa, Mount Abu, Karachi, Hyderabad (Sind), and Jacobabad.

Poona; the old Observatory at Wanowrie.—The chief object of my visit to this observatory was to compare the barometer with the travelling standards, before finally removing it and the rest of the instruments to Bombay, and closing the observatory. The index error was found to be the same as by the previous comparison in 1879. It was anticipated that this instrument, after having been in use probably for upwards of 25 years, might, when inverted for removal, be found in a leaky condition, and such was the case; but by the adoption of suitable precautions it was safely carried to Bombay, and on arrival there found to be uninjured, the index error being unaltered. The thermometers and other instruments were also carefully packed and taken to Bombay, where they were compared with the standards throughout the whole range of their variation when under observation.

The new Observatory at Yaravda.—Everything at this observatory, except the embossing anemograph, was found in good order. In my last report, I mentioned the defects of this instrument, one of which was that the apparatus which records the wind direction was very liable to get out of order. This defect has now been overcome by adding two new collars and a new brass piece, which together, prevent the connecting endless chain from slipping, while leaving it free to move without any increase of friction. The remaining great defect, *viz.*, the failure of the instrument to record calms, and the consequent loss of the time record on all such occasions, cannot be overcome in any similar manner.

Surat.—All the instruments at this observatory were found in good order. The comparisons with the standards gave the results shown in Appendix IV. The small anemometer, which at this station, is erected on a post at the Castle, 2 miles from the observatory, was in good order, but the flag used for finding the wind direction was too small and not well fixed—defects which I rectified. Instead of relying upon any makeshift arrangement for finding the wind direction, or of using vanes of the common kind, all of which give the very roughest approximations to the truth, it would, I think, be a great improvement if the small Robinson's anemometers were fitted with windmill vanes of the Beckley's pattern of a suitable size, but without any of the self-recording attachments. The instrument-makers do not include such instruments in their catalogues, but there could be no difficulty in constructing them.

Rajkot.—At this station the instruments were found in good order, but the thatch of the meteorological shed was growing thin, and the fence round the radiation thermometers needed some repairs, which have since been executed. The instruments were as usual compared with the standards, and the observer's methods of observation were carefully checked and found to be correct in every particular.

Deesa.—Everything was in good order at this station. The usual comparisons of the instruments with the standards were made, and the large anemograph was taken to pieces and cleaned, evidently not before it was needed, although the anemograms had shown no signs of a lack of freedom in the movements of the instrument.

Mount Abu.—All was in good condition except the nocturnal radiation thermometer, which had been reported broken. It was replaced by a new instrument which I had taken with me for that purpose. I noticed that the inner surface of the glass jacket of the solar thermometer was becoming slightly dimmed, particularly near the two bits of packing which support the thermometer at the upper and lower extremities of the tube. It is not improbable that this cause alone will produce a

gradual change in the readings of this instrument, and thus prevent any reliable conclusions with regard to the secular variations of the intensity of the solar rays being drawn from its indications.

Karáchi.—On arrival at this station I found the observer had died a few days before, and that the man who was taking the observations had but partially learned how to perform the meteorological duties. I put him through a course of instruction, and he has since carried on the work satisfactorily. The instruments were all in good order, as will be seen from the results of the comparisons with the standards given in Appendix IV.

Hyderabad (*Sind*).—This observatory was closed at the time of my visit, and all the instruments, except the raingauge, had been sent to the Karáchi Observatory for safe keeping, where I compared them with the standards, and found them in good order. The Hyderabad Observatory had been closed on the departure of the troops (and with them the Hospital Assistant, who was also observer,) to the frontier; and such was the demand for hospital subordinates caused by the war, that it was impossible, for several months, to re-open the observatory. The influence of the war has also been felt at several other observatories, as will be seen by the frequent changes of superintendents and observers, shown in the list which forms Appendix III. These changes are, under ordinary circumstances, much more frequent than is desirable, and when they take place, as they often must, at very short notice, it is impracticable for the new observer to be put through a proper training by his predecessor before the latter leaves the station, much more to find time for the deputation of the new man to the Bombay office for a course of instruction. The work done under such circumstances is consequently not unfrequently of an inferior character for a time.

Jacobabad.—All was in fairly good order, except the radiation thermometers, one of which had apparently burst, a day or two before my arrival. The other, the nocturnal radiation thermometer, had $4\frac{1}{2}$ degrees of condensed spirit at the upper end of the tube. The observer himself put this instrument into proper order on the defect being pointed out to him, but he said he had not noticed it, and it certainly would not have been seen without careful scrutiny; nevertheless, as the liability of these instruments to become deranged in this manner is so distinctly pointed out both in the instruction book and in a special set of memoranda pasted on a board for guidance, and as the defect is so easily rectified, there is very little excuse for having the instrument out of order.

Meteorological Erections.

The thermometer shed at Kárwár having been blown down, (fortunately without injury to more than one of the thermometers), a new one of a more substantial character has been erected. Sanction was also given, during the year, for the erection of the anemograph tower at Belgaum, and it has since been completed, and the anemograph set to work. Various needful petty repairs at other stations have also been executed.

Instruments and their Verification.

The instruments issued during the year, and the observatories to which they have been sent, are shown in the following table:—

Instruments issued between the 1st April 1880 and the 31st March 1881.

Stations.	Barometer.	Dry Bulb of Hygrometer.	Wet Bulb of Hygrometer.	Dry Maximum.	Dry Minimum.	Wet Minimum.	Solar Thermometer.	Grass Thermometer.	Anemometer.	Rain Gauge.	Rain Measuring Glass.	Total.
Jacobabad	...	...	...	...	...	...	1	1	...	...	...	2
Bickaneer	1	...	...	...	...	...	2	3	...	...	1	7
Hyderabad	...	...	...	...	...	...	...	...	...	...	...	...
Karáchi	...	...	...	2	...	...	2	...	1	...	...	5

Instruments issued between the 1st April 1880 and the 31st March 1881—continued.

Stations.	Barometer.	Dry Bulb of Hygrometer.	Wet Bulb of Hygrometer.	Dry Maximum.	Dry Minimum.	Wet Minimum.	Solar Thermometer.	Grass Thermometer.	Anemometer.	Rain Gauge.	Rain Measuring Glass.	Total.
Bhúj	...	...	...	...	...	...	...	...	...	...	...	...
Deesa	1	...	...	1	...	...	...	...	...	...	...	2
Mount Abú	...	...	...	1	...	...	...	2	...	...	...	3
Neemuch	1	...	...	...	...	...	...	1	1	...	...	3
Indore	3	...	...	...	...	...	...	...	...	...	...	3
Rájkot	...	...	...	...	...	...	...	1	...	...	...	1
Surat	...	...	...	...	...	...	...	...	1	...	...	1
Akola	...	1	1	...	...	...	...	1	...	...	...	3
Amraoti	...	...	...	...	...	...	...	...	...	...	...	...
Chikalda	...	...	...	1	...	...	...	...	...	...	...	1
Buldana	...	...	...	...	...	...	...	...	...	...	...	...
Málegaon	...	...	...	...	...	...	...	1	...	...	...	1
Poona	...	...	...	...	...	...	...	2	...	...	...	2
Sholápur	...	...	...	...	...	...	1	2	...	...	...	3
Ratnágiri	...	...	...	...	...	...	...	...	...	...	...	...
Belgaum	...	...	...	...	...	...	...	2	...	...	...	2
Kárwár	...	...	...	1	...	...	...	1	...	...	...	2
Calicut	1	1	1	...	...	...	...	...	1	1	2	7
Zánzibár	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	7	2	2	6	...	...	6	17	4	1	3	48

With the exception of one solar thermometer and two nocturnal radiation thermometers, which were furnished with correction tables when received from Calcutta, all the instruments issued were verified, as in previous years, at this office.

Training of Observers.

No observers have been trained at this office during the year, but it was necessary to send a clerk from Bombay to the Málegaon Observatory to teach the observer how to perform his duties, and an observer for the Hyderabad Observatory was trained, at Karáchi, by the observer at that station, who had been taught by myself during my tour of inspection. However desirable it may be that each observer, before being entrusted with meteorological work, should be put through a course of training at this office the fact that most of the observers hold their observerships merely as adjuncts to other offices, renders it impracticable, in the majority of cases, for them to undergo this preliminary course of instruction, and it becomes necessary to rely upon such information as they are able to obtain from their predecessors and from the instruction book, supplemented by correspondence between this office and the officers in charge of the observatories, pointing out defects as they arise, and the proper modes of correcting them. In some instances the supervising officers have taken

much interest in the work, and have afforded me very material assistance, for which my special acknowledgments are due.

Methods of Observation and Reduction.

The only change during the year in the methods of reducing the observations was the introduction of a method of correcting the indications of the anemometers for stoppages during the short intervals when they are out of action for cleaning or slight repairs. Formerly, it was the practice to reject a day's record whenever it was incomplete, but now the velocity of the wind before the stoppage, the interval of the stoppage, and the velocity after restarting the instrument, are all noted down, and it thus becomes possible to apply a suitable correction for the loss of the record during the interval of inaction.

The traces of the new Robinson-Beckley anemograph at the inland station, Deesa, have brought to light a remarkable phenomenon, which will render it necessary to modify or extend the usual methods of tabulating and reducing the records of these instruments. I allude to the very great variability of the wind direction during the day-time, and the very evident diurnal period which this variability undergoes. It is of such magnitude, and changes so rapidly, that it becomes no longer allowable, even as an approximation, to assume that the wind, for so short an interval as an hour, may, without sensible error, be regarded as blowing from a constant direction, and the task of resolving the wind into its mechanical components thus becomes exceedingly complicated, if not altogether impracticable; and the only true solution of the problem would require the use of some mechanism which would act the part played by the wind component integrator of Dr. Oettingen. Possibly some less accurate, but more convenient, method of correcting the results might be devised, but this would at least involve the tabulation of the amount of variation which the wind direction undergoes during each hour. In fact the hourly tabulations of the velocity and the *mean* direction give but a very rough idea of the wind's behaviour at an inland station. The matter is of great importance with regard to the explanation of the diurnal hot winds, or "winds of elastic expansion" as Mr. Blanford has called them, and I am by no means sure that the whole theory will not be found to lie in the fact of the great variability of the wind direction; for it is quite certain that if this element of the wind's behaviour be disregarded, the results would exhibit peculiarities such as have been pointed out by Mr. Blanford in his paper on the "Winds of Calcutta," and by myself in my paper on the "Winds of Karáchi." The great definiteness of the phenomenon above mentioned will be seen from the following statement of the mean hourly range of the variability of the wind direction at Deesa during the month of March 1881.

Hour	1	2	3	4	5	6	7	8	9	10	11	Noon.
Points	1·8	1·4	0·9	2·0	0·8	1·6	2·6	2·9	3·6	7·0	7·7	10·2
Hour	13	14	15	16	17	18	19	20	21	22	23	Midnight.
Points	8·0	8·1	5·6	5·0	1·8	1·4	2·3	1·8	2·1	2·1	2·0	2·5

In considering the significance of these figures, it must be borne in mind that there is nothing of the nature of pendulous oscillation about the wind vane of the Deesa anemograph, as it is a windmill vane of the Beckley pattern.

Character of the Meteorological Registers for the Year 1880.

With the exceptions noted below, all the meteorological registers for the year 1880 bear a high character for accuracy, and even with regard to these exceptions it is satisfactory to be able to

report that the defects are in no case due to deliberate dishonesty, but in all, as already mentioned, to lack of experience on the part of the observers when first taking up the work of meteorological registration. The exceptions are, inaccuracy of the barometric observations at Sholápur during the latter half of the month of October 1880, and erroneous readings of the barometer and anemometer during the months of August and September 1880 at Málegaon. These untrustworthy observations have been rejected.

Library.

Appendix V gives the list of books and pamphlets added to the library during the past year, and another list is appended giving the titles of the publications previously received.[1] The lists together form a complete catalogue of the works in the library, almost all of which have been presented to the office. The books have been carefully compared with the catalogue, and there are none missing.

Office Establishment.

During the past year I applied for privilege leave of absence from the 1st April to the 9th June 1880, but as arrangements for my relief were not completed until the 26th April, the period of my leave extended from that date to the 9th June, during which time Mr. A. N. Pearson acted for me. The office establishment at the end of the year stood as follows:—

Name.	Monthly Pay.
For Land Meteorology.	Rs.
Ganesh Sadashiv	48
Vajeram Icharam	33
Mahadev Ramchandra	34
Krishnaji Ramchandra	30
Ramchandra Sadashiv	30
For the Storm-Warning Service.	
Ramchandra Govind	30
Anant Vishvamber	30

There is also one menial whose pay is Rs. 10 per month.

Work of the Office.

This has mainly consisted, as in previous years, in the regular reduction and tabulation of the meteorological observations from the various observatories, for incorporation in the general annual reports of the Indian Meteorological Department. The complete monthly returns have been regularly forwarded to the Meteorological Reporter to the Government of India, and abstracts of them have been published every month in the *Bombay Government Gazette*.

A sketch of the meteorology of the Bombay Presidency in the previous year was, as usual, prepared for the General Administration Report of the Presidency, and published therein, a few spare copies being struck off for distribution to scientific men in Europe and elsewhere. In this sketch I attempted to lay down, with some approach to mathematical exactness, the very definite relation which exists between the variations of the rainfall and those of the barometric pressure, and to show how this relation would, under certain stated conditions, render it possible to forecast the general character of the rainfall of a coming monsoon season. In a special preliminary report on "Abnormal Variations of Barometric Pressure in the Tropics and their relation to Sun-spots, Rainfall, and

[1] Lists omitted.—H. F. B.

Famines," which was submitted to the Bombay Government on the 4th September 1880, and published in *Nature* on the 25th November 1880, and the 2nd December 1880, I showed how these conditions might be realised by obtaining meteorological observations from stations differing widely in longitude. This paper was forwarded to the Government of India, and I was much gratified to find, from the *Gazette of India* of the 26th February 1881, that it has led to steps being taken to establish observatories possibly at Socotra, Seychelles, and the Chagos Islands.

The introduction of the new system of daily telegraphic weather reports for storm-warning purposes has involved much work of a special character. All the arrangements connected therewith have now been made, with the exception of the establishment of direct telegraphic communication between the Meteorological Office and the Telegraph Office, and it is hoped that this will shortly be arranged in a satisfactory manner.

Copies of all the rain registers (upwards of 400 in number), showing the daily rainfall during the year 1880 at each of the rain-gauge stations in the Bombay Presidency, have been collected; and similar registers for the two preceding years have also been obtained.

F. CHAMBERS,

Meteorological Reporter for Western India.

METEOROLOGICAL OFFICE, BOMBAY,
The 24th June 1881.

APPENDIX E I.

DAILY TELEGRAPHIC WEATHER REPORT.

Thursday, the 31st March 1881.

STATIONS.	BAROMETER.		THERMOMETER IN SHADE.		HUMIDITY.		Amount of cloud at 10 A.M.	WIND.		Rain from 10 A.M. yesterday to 10 A.M. to-day.	Sea disturbance at 10 A.M.	Weather at 10 A.M.	Weather from 10 A.M. yesterday to 10 A.M. to-day.
	At 10 A.M. reduced to 32° F and Sea-level.	Rise (+) or fall (—) from 10 A.M. yesterday to 10 A.M. to-day.	Reading at 10 A.M.	Rise (+) or fall (—) from 10 A.M. yesterday to 10 A.M. to-day.	Saturation indicated by 100.	Rise (+) or fall (—) from 10 A.M. yesterday to 10 A.M. to-day.		Direction and Force at 10 A.M.	Mean Velocity from 10 A.M. yesterday to 10 A.M. to-day.				
	Inches.	Inches.	Degrees.	Degrees.	Per Cent.	Per Cent.	Scale 0 to 10		Miles per hour.	Inches.			
Karáchi ...	29·923	—·036	84·0	0·0	74	+13	0	S. W.	11	0·00	...	...	
Surat ...	30·003	—·011	84·6	0·0	79	+ 9	0	W.	12	0·00	...	...	Fine clear weather.
Bombay ...	·018	—·010	83·5	+0·7	70	0	4	E. S. E.	6	0·00	Slight.	...	Fine weather with passing clouds.
*Ratnágiri ...	...	...	...	...	...	...	...	...	...	...	...	...	
Kárwár ...	·003	—·032	80·1	0·0	69	+ 7	0	N. W. moderate.	...	0·00	Very smooth.	...	
Mangalore ...	·003	—·027	85·4	+0·5	61	0	1	S. W.	4	0·00	...	...	
Calicut ...	·004	—·024	83·6	0·0	74	+11	1	S. S. W.	8	0·00	Slight	...	
Cochin ...	·015	—·012	86·0	—1·0	70	+ 1	10	N. N. W.	2	0·00	...	Overcast	Sultry.
Masulipatam ...	·052	+·001	89·0	+1·0	63	— 3	4	S. S. E.	...	0·00	...	...	Sultry.
Madras ...	·052	—·010	90·0	+2·0	56	— 1	5	S. E.	7	0·00	...	...	Fine weather with passing clouds.
Negapatam ...	·031	—·008	89·0	0·0	63	— 3	5	E. N. E.	4	0·00	...	...	Sultry.
					Late report of the 30th.								
Cochin ...	30·027	+·014	87·0	+0·5	69	+2	10	N. W.	3	0·00	...	Overcast	Sultry.

* Telegraph line to Ratnágiri not opened till 27th May 1881.

(Signed) F. CHAMBERS,
Meteorological Reporter for Western India.

APPENDIX E II.

TELEGRAPHIC WEATHER INTELLIGENCE.

The Meteorological Office, Bombay, issues (free of charge) to ports and fishing stations approved of by the Government of Bombay telegraphic notices of atmospheric disturbances on or near the coasts of the Bombay Presidency.

SIGNALS.

The fact that such a notice has been received at any station is made known by a signal which is hoisted on the receipt of the telegram.

The signals are made by means of a canvas shape, a *Cone* during the day-time, and by means of three lanterns during the night.

The *Cone* is not less than 3 feet high and 3 feet wide at the base, and when hoisted appears as a triangle *with the point downwards.*

The lanterns are arranged in a triangle *with the point downwards.*

This signal should be made with lanterns showing a red light. The haul yards should be good rope, and protected from chafing, and the lanterns should hang at least 3 feet apart.

ON HOISTING THE SIGNALS.

The day signal is kept up till dusk, when the night signal is substituted. The day signal is again hoisted next morning, and so on *until 48 hours have elapsed from the time the telegram was despatched.* The signal is then lowered, unless a second telegram orders it to be kept up for more than 48 hours. In every case when it is thought at the Meteorological Office that the weather has ceased to be of a threatening character before the 48 hours are over, orders are issued to lower the signal at once. The time at which the warning telegram is despatched is always marked upon it.

MEANING OF SIGNALS.

The hoisting of one of these signals is intended as a sign that there is an atmospheric disturbance in existence which threatens to cause bad weather in the neighbourhood of the place where the signal is hoisted, and the knowledge of which is likely to be of use to the sailors and fishermen on that part of the coast. In every case some of the principal reasons which have led to the hoisting of the signal are explained in the telegram, which should always be kept posted up for public inspection while the signal is flying. It must be remembered that only the greater and more general disturbances of the atmosphere can be made known by this method. Local squalls of less extent, such as the "Elephanta," may be indicated to observers by their own instruments, and by local signs of weather, &c.

APPENDIX EIII.

Names of the Superintendents and of the Observers at the Meteorological Observatories in Western India during the year 1880-81.

Observatory.	Class.	Officer in Charge.	Date. From	Date. To	Observer.	Date. From	Date. To	Remarks.
Karáchi	Second	Surgeon-Major G. Hare	1st April 1880*	26th June 1880	Private J. Boyle	1st April 1880	23rd April 1880	* Approximate dates.
		J. Ryons	27th June " *	31st July "	" J. Bruce	24th " "	6th August "	
		G. Hare	1st August " *	17th August "	" J. Boyle	7th August "	7th December "	
		John Hoysted	24th " " *	10th September "	Gunner B. Pickford	8th December "	26th February 1881	
		F. R. Barker	11th September " *	22nd October "	Private R. Pope	27th February 1881	31st March "	
		H. M. Macbeth	23rd October " *	31st March 1881				
		F. W. L. Hodder	1st April "	9th February "	Private J. Bruce	1st April 1880	13th April 1880	
		Captain F. Forjett	10th February 1881	31st March "	Gunner B. Pickford	14th " "	5th September "	
					Corporal W. Birch	6th September "	31st March 1881	
Poona (Yaravada)	"	Surgeon S. M. Salaman	1st April 1880	28th February "	Surgeant T. W. Harriott	1st April "	31st " "	
		" I. P. Greany	1st March 1881	31st March "				
Belgaum	"	Surgeon-Major J. F. Brodie	1st April 1880	31st " "	Lance Corporal H. Farmer	1st "	31st "	
Jacobabad	Third	Surgeon J. M. Cloghry	1st " "	28th July 1880	Hari Bhau	1st "	31st "	
		Assistant Surgeon A. M. Rosario	29th July "	16th September "				
		Surgeon I. P. Greany	17th September "	18th December "				
		" E. Burroughs	19th December "	31st March 1881				
Bickaneer	"	No Superintendent	.....	.....	Ram Lal	1st "	4th February 1881	
					No Observer	5th February 1881	12th March "	
					Ram Lal	13th March "	31st " "	
Hyderabad (Sind)	"	Surgeon-Major R. Keith	1st April 1880†	16th July 1880	C. A. Pruce	1st April 1880	14th August 1880	† Approximate dates.
		" John Hoysted	17th July " †	14th August "				
Bhuj	"	Surgeon A. F. Sargent	1st April "	31st March 1881	Narayen Mane	1st "	31st March 1881	
Mount Abu	"	Surgeon-Major R. McMullen	1st " "	17th February "	Hospital Sergeant J. Briggs	1st "	3-st "	
		" F. W. L. Hodder	18th February 1881	30th March "				
		" C. W. Watling	31st March "					
Neemuch	"	" T. Boyd	1st April 1880	15th April 1880	T. Bachu	1st "	31st "	
		Assistant Apothecary A. X. Dias	16th " " ‡	31st March 1881	.....	.....	.....	‡ Alternately in periods of fifteen days to about a month each.
		Surgeon-Major R. Turner						
Indore	"	Dr. T. Beaumont	1st " "	31st " "	Gopál Ráo			
Rájkot	"	Surgeon H. P. Jervis	1st " "	31st " "	Sheik Dadu Mya	1st April 1880	31st March 1881	
Surat	"	Surgeon-Major C. Joynt	1st " "	3rd June 1880	Dhunjibhai Motabhái	1st " "	31st " "	
		Surgeon P. J. Damania	4th June "	5th August "		1st " "	31st " "	
		" M. B. Kolah	6th August "	2nd September "				
		Surgeon-Major T. B. Johstone	3rd September "	31st March 1881				
Akola	"	Surgeon T. Hume	1st April "	1st " "	Samuel Gregory	1st "	31st "	
		Apothecary D. Callaghan	2nd March 1881	31st " "				
Amraoti	"	" G. E. King	1st April 1880	8th " "	Bukaram Pandurang	1st "	14th "	
		1st Class Hospital Assistant Maulabux	9th March 1881	18th " "	Enock Shadrock	15th "	31st "	
		Apothecary G. E. King	19th " "	31st " "	Bukaram Pandnrang	22nd "	31st "	
Chikalda	"	Assistant Surgeon J. Vital	1st April 1880	27th August 1880	Ameenullakhan	1st April 1880	31st "	
		Apothecary D. Callaghan	28th August "	7th February 1881				
		Surgeon C. L. Sevarine	8th February 1881	31st March "				
Buldana	"	Honorary Surgeon A. R. Menasse	1st April 1880	31st " "				
Málegaon	"	Surgeon B. N. Koyaji	1st " "	31st " "	Pandurang Krishnajl	1st "	31st "	
					Ramchandra Waman	1st "	6th August 1880	
					Mr. E. O. Reilly	7th August 1880	14th " "	
					Narayen Balajl	15th "	21st October "	
Sholápur	"	" H. M. Calman	1st " "	19th May 1880	Gulab Rhan	22nd October "	31st March 1881	
		" H. B. Briggs	20th May "	31st March 1881	Parashram Swami	1st April "	21st October 1880	
Ratnágiri	"	" F. C. Barker	1st April "	24th May 1880	Davideen	22nd October "	31st March 1881	
		" C. G. Lowdell	25th May "	27th " "	Mahadev Cuddum	1st April "	31st " "	
		" H. M. Calman	28th " "	31st " "				
Kárwár	Voluntary	R. G. C. Westbrook, Esquire, Port Officer	1st April "	31st " "	G. W. M. D'Aranjo	1st April 1880	31st March 1881	
Zánzibár	"	Surgeon C. T. Peters, M.B.	1st " "	31st " "	Surgeon C. T. Peters, M.B.	1st " "	31st " "	

APPENDIX EIV.

Results of the Comparisons of the various Instruments with the Standards at the time of Inspection.

Stations.	Surat.	Rajkot.	Deesa.	Mount Abu.	Karachi.	Hyderabad.	Jacobabad.
	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
Barometer	+·002	—·009	·000	—·003	—·003	—·006	—·003
Dry Bulb	+0°·1	+0°·1	0°·0	0°·0	+0°·2	+0°·2	+0°.2
Wet Bulb	+0·1	—0·2	+0·2	0·0	+0·1	—0·1	+0·1
Dry Maximum	0·0	+0·3	+0·3	+0·1	+0·2	+0·3	—0·3
Dry Minimum	—0·1	+0·4	+0·1	—0·1	0·0	0·0	—0·1
Wet Minimum	—0·3	—0·9	0·0	—0·2	0·0	—0·1	—0·3
Grass Minimum	—0·3	0·0	+0·2	0·0	+0·4	+0·1	—0·1

The sign + indicates that the instrument read higher than the standard, and the sign—that it read lower.

APPENDIX F.

Returns showing the names of Superintendents and Observers of the Observatories in British Burmah for the year 1880-81.

Names of Stations.	Designation of Office.	Name and Rank of Officer.	Term of Service.
Rangoon ...	Superintendent ...	G. A. Dundas, Surgeon ...	From 1st to 21st April 1880.
	Ditto ...	Hugh Johnstone, Surgeon-Major...	From 22nd April 1880 till 31st March 1881.
	Observer ...	Mr. A. Sarfas	From 1st April 1880 till 31st March 1881.
	Assistant Observer ...	Mr. R. Donald	From 1st April 1880 till 31st May 1880.
	Ditto ...	Mr. A. Rahman	From 1st June 1880 till 31st March 1881.
Moulmain ...	Superintendent ...	W. F. deFabeck, Surgeon-Major...	Throughout the year.
	Observer ...	F. H. Hilbert, 2nd Class Hospital Assistant	Throughout the year.
Bassein ...	Superintendent ...	R. S. Dawson, Surgeon ...	From 1st April to 7th May 1880.
	Ditto ...	O. Baker, Surgeon ...	From 8th May 1880 to 31st March 1881.
	Observer ...	A. G. Soon, Dispensary Clerk ...	Throughout the year.
Thayetmyo ...	Superintendent ...	Oswald Baker, Surgeon ...	From 1st April 1880 to 26th April 1880.
	Ditto ...	Odeutolla, Assistant Surgeon ...	From 27th April 1880 to 25th May 1880.
	Ditto ...	B. N. Chowdry, Assistant Surgeon	From 26th May 1880 to 31st March 1881.
	Observer ...	Ahmed Ally, 2nd Class Hospital Assistant	From 1st April 1880 to 30th September 1880.
	Ditto ...	Jaun Mahomed, 2nd Class Hospital Assistant	From 1st October 1880 to 12th February 1881.
	Ditto ...	Alladin, 2nd Class Hospital Assistant	From 13th February 1881 to 31st March 1881.
Tonghoo ...	Superintendent ...	A B. Power, Surgeon-Major ...	From 1st April 1880 to 28th January 1881.
	Ditto ...	C. T. Rundle, Surgeon ...	From 29th January 1881 to 31st March 1881.
	Observers ...	J. Paul, 2nd Class Hospital Assistant	From 1st April 1880 to 28th January 1881.
	Ditto ...	V. Chinnasamy Pillay, 3rd Class Hospital Assistant	From 29th January 1881 to 31st March 1881.
Mergui ...	Superintendent ...	Devendranath Roy, Assistant Surgeon	From 1st April 1880 to 31st March 1881.
	Observer ...	Mahomed Cassim	From 1st April 1880 to 31st March 1881.

W. PEARL,
Sanitary Commissioner, British Burmah.

APPENDIX G.

Return of the names of the Superintendents and Observers at the Port Blair and Nancowry Observatories during the year 1880-81.

Port Blair.			Nancowry.		
Name	From	To	Name	From	To
Superintendents.			*Superintendents.*		
Surgeon J. Reid, M.B. ...	1st April 1880	27th May 1880	None.		
,, J. J. Routh ...	28th May ,,	15th July ,,			
,, W. Beatson ...	16th July ,,	31st Mar. 1881			
Observer.			*Observers.*		
J. T. Peters ...	1st April ,,	31st Mar. 1881	R. C. D. Prince ...	1st April 1880	19th May 1880
			C. Soobroyaioo Naidoo ...	20th May ,,	14th Aug. ,,
			V. Nummiah ...	15th Aug. ,,	6th Nov. ,,
			S. Thomas ...	7th Nov. ,,	29th Jan. 1881
			D. Guanayathum ...	30th Jan. 1881	31st Mar. ,,

Port Blair,
The 1st April 1881.

W. BEATSON, *Surgeon,*
Offg. Senior Medical Officer.

APPENDIX H.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Director of the Meteorological Observatory.
Agra	The Editor of the *Delhi Gazette.*
Ajmere	Secretary to the Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Le Général Commandant Superieur du Genie en Algerie.
Allahabad	Secretary to the Government, North-Western Provinces and Oudh. Director, Department of Revenue and Agriculture, North-Western Provinces and Oudh. Meteorological Reporter, North-Western Provinces and Oudh. Sanitary Commissioner, ditto ditto. Editor of the *Pioneer.*
Amsterdam	Secretary to the Royal Academy of Sciences.
Bangalore	Secretary to the Chief Commissioner, Mysore and Coorg. Conservator of Forests, Mysore and Coorg.
Batavia, Java	Director of the Meteorological Observatory.
Berlin	Ditto ditto Institute.

Bombay	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Superintendent of the Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
	Registrar of the Bombay University.
	Secretary to the Asiatic Society of Bombay.
	Superintendent of the Bombay Sassoon Mechanics' Institute.
	Secretary to the Geographical Society of Bombay.
	Editor of the *Bombay Gazette*.
	Ditto *Times of India*.
	Principal of the Elphinstone College.
Brisbane, Queensland ...	Superintendent of the Observatory.
Brussels	Secretary to the Royal Academy of Sciences.
	Director of the Observatoire Royal.
Budapesth	Ditto Observatory.
Buenos Aires	Ditto Meteorological Office.
Calcutta	Secretary of State for India (through Revenue and Agricultural Department).
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto, Home Department.
	Ditto ditto, Public Works Department.
	Ditto ditto, Foreign Department.
	Ditto ditto, Department of Finance and Commerce.
	Ditto ditto, Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Surveyor General of India.
	Superintendent, Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanic Gardens, Calcutta.
	Inspector General of Forests, with the Government of India.
	Secretary to the Surgeon-General, ditto ditto.
	Ditto Asiatic Society of Bengal.
	Librarian, Indian Museum Library.
	Registrar of the Calcutta University.
	Principal of the Presidency College.
	Librarian, Public Library.
	Editor of the *Calcutta Review*.
	Ditto *Statesman and Friend of India*.
	Ditto *Englishman*.
	Ditto *Indian Daily News*.
	Ditto *Hindoo Patriot*.
	Ditto *Indian Agriculturist*.
Cambridge	Reverend E. Lafont, S.J.
Cambridge, Massachusetts ...	Librarian of the University Library.
	Ditto Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Germany	Director of the Baden Meteorological Observatory.
Chatham	Librarian, Royal Engineers' Library.
Christiania	Director of the Norske Meteorologiske Institut.
	Ditto Royal Observatory.
Colombo	Editor of the *Ceylon Times*.
	Ditto *Ceylon Observer*.
	Surveyor General of Ceylon.
Constantinople	Director of the Observatoire Imperial Météorologique.
Copenhagen	Secretary to the Danske Meteorologiske Institut.
	Ditto Royal Danish Academy of Sciences.

Darjeeling	Conservator of Forests, Government of Bengal.
	Editor of the *Indian Forester*.
Dehra Dun	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Dublin	Registrar, Royal Dublin Society.
Edinburgh	Secretary to the Scottish Meteorological Society.
	Astronomer Royal for Scotland, Royal Observatory.
Ellichpore	Assistant Conservator of Forests, Melghat Division.
Goa	Director General, Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Guatemala	Director of the Observatorio Meteorologico del Institut Nacional de Guatemala.
Hamburgh	Director of the Nord Deutsche Seewarte.
Havana	Ditto Real Collegio de Belen.
Hong-Kong	Superintendent, Government Civil Hospital.
Indore	First Assistant Agent to the Governor General for Central India in charge of the Residency.
Iowa, U. S.	Director of the Iowa Weather Service.
Jubbulpore	Civil Surgeon of Jubbulpore.
Katmundu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests, Bombay, Sind Division.
Lahore	Secretary to the Government of the Punjab.
	Meteorological Reporter ditto ditto.
	Sanitary Commissioner ditto ditto.
	Conservator of Forests, Government of the Punjab.
	Editor of the *Indian Public Opinion*.
Leipzig	Director of the Observatory.
Lisbon	Director of the Observatoire de Infante D'Luiz.
	Secretary to the Academy of Sciences.
London	Secretary to the Meteorological Council.
	Ditto Royal Society.
	Ditto Royal Asiatic Society.
	Ditto Society of Arts.
	Ditto Meteorological Society.
	Librarian, Royal School of Mines.
	Ditto Admiralty Library.
	Ditto United Service Museum.
	Chief Librarian, British Museum.
	Editor of the *Philosophical Magazine*.
	Ditto *Athenæum*.
	Ditto *Nature*.
	Ditto *Symon's Monthly Meterological Magazine*.
	Ditto *Westminister Review*.
	Ditto *Quarterly Review*.
Madras	Secretary to the Government of Madras.
	Meteorological Reporter to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, Government of Madras.
	Registrar of the Madras University.
	Editor of the *Madras Times*.
	Ditto *Madras Athenæum*.
	Superintendent, Government Central Museum.
	Ditto Ditto Farm, Saidapet.
Madrid	Director of the Royal Observatory.
Manchester	Secretary to the Literary and Philosophical Society.

Manila	Director of the Meteorological Observatory.
Mauritius	Secretary to the Meteorological Society.
Melbourne, Victoria	Director of the Observatory. Librarian of the University Library. President of the Public Library.
Mexico	Director of the Central Meteorological Observatory.
Milan	Ditto Royal Astronomical Observatory.
Munich	Ditto Royal Observatory. Ditto Royal Bavarian Academy of Sciences. President, Geographical Society. Professor Dr. Carl Asendts—Editor of the *Deutsche Rundschau für Geographie und Statistic.*
Nagpur	Secretary to the Chief Commissioner, Central Provinces. Sanitary Commissioner, ditto. Inspector General of Education, ditto. Civil Surgeon, Central Jail. Conservator of Forests, Central Provinces.
Naini Tal	Ditto ditto, North-Western Provinces and Oudh.
New Haven, Connecticut ...	Secretary to the Connecticut Academy of Arts and Sciences. Editors of the *American Journal of Sciences.*
New York, U. S.	Director of the Central Park Observatory.
Ootacamund	Conservator of Forests, Government of Madras. Editor of the *South of India Observer.*
Oxford	Librarian of the Radcliffe Library. Radcliffe Observer, Radcliffe Observatory.
Paris	Director, Observatoire Physique Central de Montsouris. Editor of *La Nature.* Director of the Physical Observatory, Meudon. Ditto Bureau Central Meteorologique.
Perpignan, France	President Commission Meterol. des Pyrénées Orientales.
Perth, W. Australia	Surveyor General.
Pesaro, Italy	Director of the Royal Observatory.
Philadelphia	Secretary to the Franklin Institute.
Poona	Conservator of Forests, Bombay, Northern Division.
Prag, Bohemia	Director of the Observatory.
Raipur	Civil Surgeon of Raipur.
Rangoon	Secretary to the Chief Commissioner, British Burmah. Sanitary Commissioner, ditto. Conservator of Forests, ditto. Editor of the *Rangoon Times.*
Rome	Director, Meteorological Office (Ministry of Agriculture).
Saharanpur	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Secretary to the Chief Commissioner of Assam. Deputy Conservator of Forests, ditto.
Simla	Quarter Master General of India, Intelligence Branch.
Singapore	Colonial Surgeon, Straits Settlements.
Stockholm	Director of the Nautisk Meteorologiska Byran.
St. Petersburgh	Ditto Observatoire Physique Central.
Strasbourg	Librarian, Imperial University Library.
Sydney	Director of the Observatory. Librarian of the University Library.
Syracuse, Sicily	Director of the Royal Meteorological Observatory.
Tasmania	Secretary to the Royal Society.
Tiflis, Russia	Director of the Physical Observatory.
Tokei-Japan	Ditto Imperial Mining Office. Ditto Imperial Meteorological Observatory.

Toronto, Canada	Director of the Magnetical and Meteorological Observatory.
Turin	Ditto R. Osservatorio Astronomico di Torino.
Upsala	Ditto Meteorological Observatory.
Utrecht	Secretary to the Royal Dutch Meteorological Institute.
Vienna	Director of the K. K. Central Anstalt für Meteorologie und Erdmagnetismus.
	Ditto K. K. Geologische Reichsanstalt.
	Secretary to the Imperial Academy of Sciences.
	Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
Washington, U. S.	Chief Signal Officer, United States Army.
	Secretary to the Smithsonian Institution.
	Director of the Naval Observatory.
	Ditto Hydrographic Office.
	Professor Cleveland Abbe, Signal Office.
Wellington, New Zealand ...	Director of the Observatory.
Woolwich	Librarian of the Royal Artillery Library.
Zi-ka-wei, Schanghai	Director of the Magnetical and Meteorological Observatory.
Zurich	Ditto Central Meteorological Institute.

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REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1881-82.

DURING the past year, the work of the Department has been carried on in the same manner as in the previous year, and without any important extension or modification. But in the early part of the year 1881, a report was called for by the Government of India, with a view to extending the utility and efficiency of the Department in certain specified directions, and this report having been submitted on the 8th June, and, after due consideration, sanctioned in its principal provisions by Government orders (Department of Revenue and Agriculture, No. $\frac{1}{27-39}$, of the 27th October 1881), preparations were in progress during the latter part of the year for giving effect to the measures thus sanctioned, and which, as far as practicable, became operative at the close of the year under report. A detailed account of these changes will more fitly find place in the report of the year now current. A summary of their principal features has already been given in the Introduction to the Report for 1880-81.

In the introductory portion of last year's report, I briefly noticed some subjects of especial interest, to which attention had been given during the year under review. A similar course will be followed in the present report.

Solar Physics.—The only branch of work in connection with this enquiry, which falls within the domain of the Meteorological Department, is the measurement of the intensity of the solar heat. The quantity of heat emitted by the sun within a given interval of time, and the variations which this quantity may undergo in different years or in shorter periods of time, are obviously questions of fundamental importance to meteorology; seeing that all meteorological action whatever, (with the most trivial exceptions) is the effect of the solar radiation; and that, in accordance with a fundamental principle of philosophical reasoning, the effects, however complex, must vary with the magnitude of the cause. Observations of the temperature to which a thermometer is raised by

exposure to the solar radiation [1] have therefore been always a recognised part of the meteorological work of the Indian observatories, and, indeed, have received more attention, and have been more generally recorded, than is the practice at observatories of a similar class in European countries. But, notwithstanding that many precautions have been introduced in the use of these instruments, the temperatures shewn by them are so greatly dependent on the state of the atmosphere, that it is still a question whether it is possible to obtain from the registers any trustworthy indication of variations of the extra-terrestrial solar intensity. They afford a rough, comparative indication of variations in the amount of heat that reaches the earth's surface, itself a not unimportant datum in meteorological enquiry; and I have reason to believe that, when properly selected and discussed, the registers may afford indications of the greater fluctuations in the solar radiation, but this is the utmost that can be asserted at present.

An actinometer, such as that invented some years since by Professor Balfour Stewart, presents the advantages, that, in the first place, its measurements are, to a great extent, independent of surrounding terrestrial objects; and secondly, that it affords a measure of the quantity of heat received; not merely of a temperature, some of the conditions affecting which are variable to an unknown extent; but, like the sun thermometer, it indicates only the quantity of heat that has penetrated the atmosphere; and the great and variable absorption of solar radiation exercised by the atmosphere, which is the great difficulty in the way of determining variations in the radiation of the sun itself, affects the readings of the actinometer equally with those of the simpler instrument.

It has been thought that a country, such as India, would be eminently favourable for actinometric work, owing to the great preponderance of sunny over cloudy days which it affords. This, however, is not the case. Although clear days, as they would be entered in a meteorological register, are of frequent occurrence, and in the drier parts of India, even preponderate over those on which visible cloud is recorded, the haze, which is the almost constant accompaniment of fine dry weather, is as inimical to actinometric observations as actual cloud; and this haze is not only very variable in intensity, but, as a rule, extends to a height exceeding that of the Himalayan hill stations.

The actinometric registers that have been kept at the Alipore observatory for more than two years, although they may prove useful for meteorological discussion, will hardly, I expect, afford much direct evidence on the supposed variations of the sun's radiant energy. During the last year, Mr. J. B. N. Henessey has made, at Mussooree, some observations with the Stewart's actinometer, lent to him by this Department; and from a letter lately received from him, I learn that, at that hill station, even a visibly clear day is not very common; and this quite accords with my own experience at Simla. Some

[1] It may not be superfluous to note here, in correction of a widely disseminated but most erroneous belief, that these observations are far from shewing the temperature of the sun, and that the question so frequently asked by persons unacquainted with the subject, "What is the temperature of the sunshine?" is one to which no definite answer is possible; since it entirely depends on the construction of the thermometer used, and on the nature and position of other objects surrounding it. A thermometer, the bulb of which is coated with lamp-black when exposed to sunshine, will acquire a much higher temperature than one with a naked glass bulb; and if the former be further enclosed in a glass tube from which the air has been exhausted, the temperature will again be increased by 30° or 40° in full sunshine. Again, if such a thermometer be placed in a small box lined with black cloth, the temperature shewn will again be raised many degrees, and, indeed, the theoretical limit of its temperature is no other than that of the sun itself, which far exceeds any terrestrial temperature that we are acquainted with. The temperature shewn by a thermometer exposed to sunshine is that at which, in each second of time, it radiates away to surrounding objects, exactly as much heat as the sun pours into it. The more this loss of heat is obstructed, the higher will be the temperature acquired.

useful work may perhaps be done at these or other hill stations; but, at present, it would seem that we must go to much greater heights, or, at all events, take refuge in the clearer atmosphere beyond the great snowy range, in order to obtain conditions favourable for observations on the sun's radient intensity.

The station of Leh having been selected for this purpose, on the recommendation of the Solar Physics Committee, the Secretary of State has been asked to send out a sapper, who has been selected by the Solar Physics Committee, and is now being trained in the work of observation at South Kensington. On his arrival, which it is expected will take place during the present season, he will be despatched to Leh, to commence work under the superintendence of Mr. Ney Elias, the British Joint Commissioner. An assistant, a native of India, will be provided, who may learn the work of observation during the two years, during which it is proposed that the sapper shall remain at Leh; and be prepared to carry it on after the latter's departure.

Apart from questions of Solar Physics, the heating power of the sun's rays at the earth's surface is, however, an important meteorological datum; and for this purpose alone, it would be well worth continuing the present system of actinometric measurement at Calcutta, and this will not be relinquished.

During the past year, sunshine recorders, for the purpose of registering the duration of sunshine, have been procured for the principal observatories, and one of these has been in use for some months at Allahabad.

RAINFALL STATISTICS AND MAP.—During the past year, some additions have been made to the list of the stations that regularly report rainfall to the Calcutta Meteorological office, by establishing rain-gauges at remote stations in the extreme south of the Mirzapur district, in the Tributary Mehals of Orissa, and in the eastern districts of the Central Provinces. An additional rain-gauge station has also been established in Rajputana; and steps are being taken by Dr. Hendley, the Residency Surgeon of Jeypore, to establish some others in the dry tract to the west of that station.

The new stations which have furnished registers for a portion of last year are—

Dudhi in Mirzapur	from August	1881.
Partabgarh in Rajputana	,, ,,	,,
Charchika in the Tributary Mehals of Orissia.	from November	1881.
Keonjhur ditto ditto	,, December	,,
Angul ditto ditto	,, November	,,
Saragaon in the Central Provinces	,, ,,	,,

Some others will appear in the rainfall lists of the year now current. Registers are also received from five additional stations in Mysore, *viz.*, Kolar, Tomkur, Chitaldrug, Chikmangalur and Hassan.

With reference to the remarks, made in the Report of last year, on the rain-gauges in use at certain stations in the North-Western Provinces and Bombay, I have lately learned that the Government of the former province have directed that Symons' gauges be supplied to the sudder stations not previously furnished with them; in Bombay, gauges of the same pattern were supplied generally to supersede the old and defective gauges in 1877.

The discussion of the rainfall statistics of India in past years has been continued, as far as has been practicable, in the intervals of more pressing work; but the progress made

has been less than I had hoped; my time having been so much occupied with these latter duties that but little leisure has been afforded for the former special work. The scope of the work, as originally sketched out, has, too, been much extended by a resolution adopted in consultation with the Secretary to the Government of India in the Department of Revenue and Agriculture, and the Surveyor General, to draw up a large scale map of the rainfall of India; the data to be laid down, on a contoured map of India, which the Surveyor General has undertaken to prepare specially for the purpose. This, as regards the rainfall, will involve the collection and reduction of all available rainfall registers, including those of sub-divisional and tehsildari stations, numbering altogether nearly 2,000 stations; and as the majority of them have been recorded only during 10 or 12 years or less, these latter must be corrected to values equivalent with those of the older registers, by factors deduced from the latter, and applied according to the geographical position of each station. The work is therefore very considerable; but the high importance of a trustworthy detailed rainfall map of India is such, that no labour bestowed on its preparation can be considered ill-applied. Some progress has been made in collecting and discussing the data, and I am in hopes that the whole may be ready, by the time that the new contoured map is ready for receiving them.

STORM-WARNING SYSTEM, CALCUTTA.—The improved form of daily report, illustrated by a chart, which was noticed in my report for last year, has been issued regularly from the Meteorological office of Bengal throughout the year. This requires the constant presence of a scientific officer; but in the cold season there is little difficulty in securing this, as the Meteorological Reporter for India can take over the duty when the Reporter for Bengal is absent in his inspection tours. During the Simla season, however, the work is very onerous and exacting; and in the event of Mr. Eliot being temporarily absent or disqualified by illness, it might be unavoidable that the report should be issued without chart or remarks; but this has not yet occurred.

During the past year, Mr. Eliot has devised a new and improved system of signals for the port and the signalling stations on the Hooghly below the port, which will afford more precise and detailed information, respecting the weather on the Bay of Bengal, than those hitherto in use. Our knowledge of storm phenomena on the Bay of Bengal has been so much advanced, in recent years, by the careful study of the storms of the Bay, that Mr. Eliot considers it practicable to distinguish between large and small storms, and, to a certain extent, to anticipate the course that they will follow; a matter of great importance to outgoing ships, as it will enable them to be prepared for veering or backing winds respectively. The new system of signals makes provision for this special information, and includes also general signals for indicating bad weather, when the actual existence of a cyclone is still in doubt. The system has lately been sanctioned by the Government of Bengal, and will shortly be brought into operation.

STORM-WARNING SYSTEM, BOMBAY.—This has been carried on during the last year on the system described in last year's report. Mr. Chambers does not publish any daily report; the information received is communicated to the Port Officer, and certain of the local newspapers are allowed to have copies, if desired. One useful piece of work performed by Mr. Chambers, in connection with the storm service, has been to draw up a list of the storms, of which he has found any recorded notice in published works or in the unpublished records of the observatories. He has found, or has himself recorded, notices

of seventy storms in all, some of which have passed across from the Bay of Bengal; others were formed apparently on or near the west coast of India; and finally, some which appear to be land-formed storms, as far as can be judged from the meagre information available. As a first step towards the study of the storms of the west coast, the list is an interesting one, and I propose to publish it with a few additional notes in the Indian Meteorological Memoirs.

GROUND TEMPERATURES.—This important class of observations, which, as far as regards this department, was first set on foot in April 1878, has received an important extension during the past year. At the beginning of the year, they were recorded at two stations, Calcutta (Alipore) and Allahabad, by thermometers at the ground surface (or $\frac{1}{2}$ inch beneath it) and at depths of one foot and three feet. Dr. Hendley, the Superintendent of the Maharajah's Observatory at Jeypore, commenced a series of similar observations in August, with thermometers at the surface, and buried one foot, three feet, and ten feet deep, to which has subsequently been added a thermometer at 20 feet deep. Mr. J. B. N. Henessey, M.A., F.R.S., of the Survey of India, has also commenced a series at depths of 1 foot, 3,2, 6,4, 12,8 ft. and 25,6 ft.; at the first three depths, with duplicate instruments. Abstract results of all these series will be published in the meteorological report for 1881, now in course of preparation.

FIRST-CLASS OBSERVATORIES.—Although the establishment of a first-class observatory at Allahabad can scarcely be said to be more advanced than at the date of my report of last year, the Maharajah of Jeypore's observatory has been rapidly organised as such, by the exertions of Dr. Hendley, and may be expected to be in working order in the course of a few weeks. As announced in my last report, any prospect of establishing a first-class observatory at Lahore must be regarded as a still distant possibility, and I therefore recommended that, in order to utilise the Van Rysselberghe's meteorograph, which had been procured from England for that station, it should be offered to the Maharajah of Jeypore, who was anxious to procure a similar instrument for his own observatory. The purchase having been sanctioned by Government, steps were immediately taken to construct a special building for its reception; and this is now ready, and the setting up of the instrument nearly completed. I have remarked, in my former report, that the situation of Jeypore in the dry, eminently continental climate of Rajputana, and on the border of the desert tract, is one, the detailed registers of which, recorded by so perfect an instrument as the Van Rysselberghe meteorograph, promise to be of the highest interest, and meteorological science will owe much to the enlightened liberality of the Maharajah of the State.

The delays at Allahabad have arisen out of circumstances unconnected with this Department, *viz.*, a proposal to establish an agricultural school at Cawnpore, and to remove the Meteorological Office of the N.-W. Provinces, and with it the proposed first-class observatory to that station. Pending the decision of the Secretary of State on this scheme, any further steps for establishing the Observatory must remain in abeyance.

EXTENSION OF OBSERVATORIES.—In the report for last year, mention was made of a proposal to establish observatories at Socotra and the Seychelles, if found practicable. The assistance of the Political Agent at Aden was solicited for this purpose and most cordially conceded. But as regards Socotra, the scheme proved to be impracticable, as there is no person resident on that island by whom the work could be undertaken with any

prospect of success. With respect to the Seychelles, Mr. Meldrum, the Director of the Royal Alfred Observatory at the Mauritius, has for some time past received registers from a Government officer resident at Victoria, to whom he had supplied instruments; and the Chief Civil Commissioner recommended that the meteorological registration for this Department should be entrusted to the same person. Accordingly, the instruments and other necessary articles of outfit were despatched to the Seychelles, and duly reached the island; but, meanwhile, the officer who had agreed to undertake the work had died, and there has been some little delay in finding a competent successor. I have now just received information, through the Political Agent at Aden, that the duty has been undertaken by Mr. James Brodie, to whom the instruments have accordingly been made over; and the Chief Civil Commissioner having very kindly granted a site for the thermometer shed in the grounds of Government House, the instruments will be speedily set up, and Mr. Brodie expects to be ready to commence the work about the middle of June.

The observatory at Amini Divi was in working order during the whole of last year,—indeed since September 1880; but the registers having been sent to the Madras Office, from which they have not yet been transmitted to me, I am unable to form an opinion on the character of the work.

Mr. Hill has established two additional observatories in the outer Himalaya, at Pauri and Pithoragarh[1], and steps are being taken to obtain observations from stations in the interior of the mountain region, from which reports on the state of the snows may be obtained periodically. An additional observatory has also been sanctioned in Assam; but the station originally proposed—Gauhati—appears to offer no favourable site for the purpose; and the further consideration of the subject stands deferred, until one of the meteorological officers can visit Assam and select a suitable site.

One observatory which promised to become of great importance to the system, *viz.*, Gilgit in Cashmere, has been unavoidably relinquished, owing to the withdrawal of the resident European officers in July last. The loss is very greatly to be regretted, as it was working admirably, and the situation, far in the interior of the mountain region, and at the northernmost extremity of the Indian system, was such as to render the information, afforded by it, unique in value and kind. The observatory, established at Ootacamund on the Nilgiris, has also ceased to contribute registers. This observatory was established on the voluntary system in October 1879, on the application of Major Morant, R.E., and yielded excellent work. But, as is almost invariably the case with these voluntary observatories, no sooner had the founder left, than the work was found to be an unwelcome addition to the duties of the establishment. An observer's allowance on the usual scale was applied for, and, as the observatory had really been useful, was sanctioned by Government in October 1881. Meanwhile, however, the meteorological work had become an incubus not to be borne, and, notwithstanding the grant of an allowance, it was found that the work could not be carried on. It was therefore closed in March 1881. Such is usually, if not invariably, the result of volunteer observatories in India, when undertaken by persons who are not permanent residents.

MARINE METEOROLOGY.—The discussion of the data, extracted from the meteorological logs, in the possession of the London Meteorological Office has been deferred, until the arrival of a scientific assistant shall have increased the working strength of the

[1] The registers commenced in June and May respectively, 1881.

office. The assistant, Mr. W. E. Dallas, who is expected to arrive in the course of a few weeks, has been instructed, with the permission of the Meteorological Council of the Royal Society, to learn the methods of work pursued, in reducing and discussing this class of data, in the London Meteorological Office; and the discussion of the data for Indian seas will be taken in hand as soon as possible after his arrival. Mr. Eliot has meanwhile made a preliminary examination of a portion of the data.

Mr. Eliot has also arranged for regular observations being made with verified instruments on the Government light-vessels stationed at the Sandheads, and in the intermediate channels of the Hooghly and Mutlah rivers; and has also obtained meteorological extracts from the logs of several vessels entering the port. Arrangements were in progress, during the year, to extend the collection of similar data, in a systematic manner, to all vessels that visit Calcutta. These have now been completed, with the assistance of the Port Officer, and the extended system came into operation at the beginning of the year.

CALCUTTA TIME SIGNALS.—The time ball on the top of the Port Commissioners' Office having been brought into working order, was dropped regularly at 1 P.M. mean, Calcutta time, from the 1st April 1881, in accordance with the announcement in the report of last year. At the same time, the service of the old time ball, on the semaphore tower of Fort William, was discontinued; and steps were taken to have it removed and replaced by the new ball and apparatus constructed by Messrs. Varley & Co. After some delay, this work was taken in hand and completed by the Garrison Engineer in January 1882. The electrical apparatus and the connections were then set up by the Electric Telegraph Department; but some further delay was incurred, by waiting for the construction of a new and much more direct line of communication between the observatory and the semaphore tower, and the new time ball was brought into use as a regular service, in conjunction with the Port Commissioner's time ball, after the close of the year under report, *viz.*, on the 8th May 1882.

At the same time that a new time ball was ordered for the semaphore tower in Fort William, an apparatus for firing the time gun by electricity was also ordered from the same maker. This consists of an induction coil, the primary current through which, from a local battery, is cut off by the action of the signal current, transmitted from the observatory; and the induction current, thus produced, fires the fuse of the time gun. On examination at the Electric Telegraph Workshops, the insulation of the coil was found to have fallen so low, in consequence, it is presumed, of the influence of the climate, as to render the apparatus unworkable; and the coil was accordingly sent home to be rewound, together with a report on its condition furnished by the electricians of the Electric Telegraph Department. On arrival in England, the coil was tested by the makers, and reported to have preserved its insulation perfect. It was rewound and returned to Calcutta, and having been again tested at the Electric Telegraph Workshops, it is found to be effective, the resistances reported being —

Primary coil	4·2 Ohms	Conductors.
Secondary	43·4 ,,	
Insulation of coils	22·03 Megohms.	

Meanwhile, arrangements have been made for setting up the gun-firing apparatus, close to the battery from which the time gun is fired. An empty expense magazine has been made ready for the purpose, and it is expected that the apparatus will be at work very shortly.

OBSERVATORIES.

The list of observatories in operation during the whole or part of the year ending 31st March 1882 is the same as that given at page 5 of the Administration Report for 1879-80, with the following additions :—

Three extra Indian observatories at Zanzibar, Aden, and Amini Divi (Lakadives) ;
One at Chowringhee, Calcutta, in connection with the Meteorological Office (4th class) ;
One private observatory at Jeypore ;
Two voluntary observatories at Pauri and Pithoragarh in Kumaon ;
A second-class observatory at Dhubri in Assam ;
And a third-class observatory at Darjeeling, which was established on the 1st October 1881, and will supersede the existing observatory at that station ;
A third-class voluntary observatory at Ghazipur, established in January 1881 ;

And the following deductions :—

Thull, on the Afghanistan frontier, abandoned in February 1881 ;
Ootacamund, relinquished in March 1881 ;
And Goalpara, which was abandoned in March 1881, the instruments being transferred to Dhubri.
The observatory of Gilgit was abandoned, as already mentioned, in July 1881, and was therefore in existence during a part of the year.

There were six additions to the list of stations in 1881 ; and three observatories, which had contributed registers during the whole or part of the preceding year, were struck off, making a net addition of three to the list for 1880-81, and raising the number of working observatories to 124. These were distributed in the different provinces as follow :—

Indian Empire.

Bengal and Assam	22
North-Western Provinces and Oudh	17
Punjab	11
Central Provinces	11
Berar	5
Central India and Rajputana	10
Bombay	14
Madras, Mysore, Coorg and Hyderabad	15
British Burma	8
Bay Islands	2
Lakadives	1
TOTAL	116

Extra Indian Settlements and Foreign States.

Nepal	1
Kashmir Territories	2
Beluchistan	1
Goa	1
Persian Gulf	1
Aden	1
Zanzibar	1
TOTAL	8

Of the whole number, two were first-class observatories, with instruments registering autographically ; twenty-four, (during the whole year), and two (during a part of the year),

second-class observatories; at all but two of which, in addition to observations at 10 hours and 16 hours, hourly readings are registered on four (or in some cases three) days in each month; at all but one of these latter, synoptic observations are also registered daily, at 7 hours 10 minutes Washington mean time, (=18 hours 1 minute Calcutta mean time). The remainder, with four exceptions, are third-class stations, registering two full sets of observations, (and in the case of certain of the Madras stations, three sets) daily. The four excepted stations—Chowringhee (Calcutta), Mongpoo, Demagiri, and Makhla—register only temperature, humidity, rainfall, and wind direction. The observatories may be further classed as—

	Class.			
	1st.	2nd.	3rd.	4th.
Government observatories with paid observers under the Meteorological Department	1	24	80	1
Independent or attached to Government Offices, observers not paid by the Meteorological Department	1	0	7	4
Private and foreign observatories	0	2	4[1]	0
TOTAL .	2	26	91	5

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character; and an important part of its work is the control of the time signals for the port of Calcutta. It is immediately superintended by the Reporter to the Government of India; and the establishment is under the immediate charge of the Chief Observer, Baboo Brojo Mohun Rukhit, B.A.

The work of the observatory consists of—

1*st.*—Continuous registration, by autographic instruments, of the atmospheric pressure, temperature, moisture (dry and wet bulb thermometers), wind direction, movement and pressure, and the rainfall.

2*nd.*—Periodical readings of the barometer, dry and wet bulb thermometers (including maximum and minimum), the rain-gauge and the actinometer, and estimates of cloud proportion. The temperature readings include those of the temperature of the air in shade, under a shed of the usual pattern, also in shaded cages at 4 feet and 40 feet above the ground; those of nocturnal radiation and insolation, and those of the ground at the surface, and at 1 foot and 3 feet deep.

3*rd.*—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporters for Western India and Madras; and the comparison of all barometers with the Calcutta standard.

4*th.*—The determination of the mean local time, by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port.

The establishment, for these purposes, consists of—

Babu Brojo Mohan Rukhit, B.A.	Chief Observer.
,, Khetra Mohan Mukherjee	1st Photo. Asst.
,, Mahendra Nath Bhattacherjee	2nd Ditto.
,, Mahendra Nath Banerjee	Observer.
,, Shyam Lall Sen	Ditto.

2 Artificers.[2]

1 Batteryman.[2]

6 Servants.

[1] Two of these were furnished with instruments by the Meteorological Department; and at the close of the year one was brought on to the paid list.

[2] Employed for the time-ball apparatus.

The autographic instruments consist of a Kew barograph and thermograph, which register by photography, a Beckley's anemograph, an Osler's anemometer, and a Beckley's rain-gauge. During the past year, all these intruments have worked fairly well; excepting that the photographic traces, during the hot weather still fall far short of what is to be desired; and the irregularity of the results, under identical atmospheric conditions, lead me to infer that a part at least of the comparative failure is owing to want of care, cleanliness, and practical intelligence on the part of the assistants. Very few of the records have been absolutely lost; but the traces are frequently so much fogged that there is considerable difficulty in obtaining their measurements. The anemograph and rain-gauge, which record mechanically, present no difficulties, and give very satisfactory results.

The following table gives a comparative view of the mean results of the autographic registers of the barograph and thermograph, and of the eye observations of the barometer and thermometers recorded at the same hours. The standard barometer has the cistern about one foot higher than the barograph, and the standard thermometers are exposed under a shed open all round, while the bulbs of the thermograph are under a louvred pent-house, against the north wall of the observatory.

Comparative mean reduced readings of barograph and standard barometer in 1881.

	Standard Barometer.					Barograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January 1881 . .	30·053	30·127	29·997	30·062	30·060	30·056	30·136	30·004	30·073	30·067
February „ . .	29·987	·057	·917	29·997	29·990	29·991	·066	29·925	·006	29·997
March „ . .	·903	29·974	·840	·919	·909	·906	29·982	·853	29·926	·917
April „ . .	·739	·789	·656	·742	·732	·751	·801	·666	·752	·743
May „ . .	·685	·733	·617	·702	·684	·686	·741	·621	·708	·689
June „ . .	·542	·585	·496	·573	·549	·540	·587	·490	·577	·549
July „ . .	·529	·558	·474	·556	·529	·525	·562	·473	·557	·529
August „ . .	·594	·636	·539	·624	·598	·595	·643	·545	·632	·604
September „ . .	·685	·735	·623	·715	·690	·688	·749	·633	·725	·699
October „ . .	·809	·860	·752	·821	·810	·812	·871	·759	·830	·818
November „ . .	·933	·987	·865	·930	·929	·932	·995	·872	·943	·936
December „ . .	30·025	30·083	·950	30·026	30·021	30·022	30·092	·958	30·039	30·028
Year . .	29·790	29·844	29·727	29·806	29·792	29·792	29·852	29·733	29·814	29·798

Comparative mean readings of the thermograph and the dry bulb thermometer in the thermometer shed, in 1881.

	Thermometer in shed.					Thermograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January 1881	54·2	67·7	75·2	58·6	63·9	55·8	66·3	74·0	59·7	64·0
February „	62·7	75·4	84·1	68·1	72·6	64·1	74·1	82·4	69·0	72·4
March „	68·3	79·7	85·2	72·8	76·5	69·4	79·2	84·7	73·8	76·8
April „	77·0	88·0	94·6	80·4	85·0	78·2	88·4	94·9	81·6	85·8
May „	78·1	86·8	89·3	79·9	83·5	79·1	87·5	89·7	81·2	84·4
June „	79·8	84·6	85·0	81·0	82·6	80·6	85·1	85·8	81·8	83·3
July „	79·8	83·8	84·4	80·9	82·2	80·6	84·8	85·3	81·7	83·1
August „	79·5	83·0	83·9	80·8	81·8	80·1	84·0	84·9	81·4	82·6
September „	79·5	84·7	85·1	80·1	82·4	80·2	85·3	86·2	81·1	83·2
October „	74·4	83·3	84·8	76·6	79·8	75·2	83·1	84·8	77·2	80·1
November „	64·1	76·0	80·8	68·1	72·3	65·4	75·1	79·9	68·7	72·3
December „	55·8	68·7	75·5	59·6	64·9	57·1	67·1	74·3	60·2	64·7
Year	71·1	80·1	84·0	73·9	77·3	72·2	80·0	83·9	74·8	77·7

Comparative mean readings of the thermograph and the wet bulb thermometer in the thermometer shed, in 1881.

	Wet bulb in shed.					Thermograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January 1881	52·4	58·0	59·8	55·6	56·5	53·0	57·4	59·7	56·2	56·6
February „	61·1	65·7	64·6	63·8	63·8	61·6	65·5	65·4	64·3	64·2
March „	66·4	70·2	69·9	68·7	68·8	67·2	70·6	70·6	69·8	69·6
April „	75·4	77·5	76·7	77·1	76·7	76·0	78·4	77·8	78·0	77·6
May „	76·1	78·9	79·0	76·7	77·7	76·2	79·5	79·6	77·1	78·1
June „	78·6	80·1	80·1	78·9	79·4	79·0	80·8	81·0	79·4	80·1
July „	78·5	79·9	79·8	79·1	79·3	78·9	80·6	80·7	79·6	80·0
August „	78·4	79·6	79·8	79·1	79·2	78·7	80·4	80·8	79·4	79·8
September „	78·4	79·9	79·7	78·4	79·1	78·8	80·6	81·0	79·2	79·9
October „	73·5	75·8	74·9	74·7	74·7	73·9	76·3	75·7	75·1	75·3
November „	61·8	66·4	66·7	64·5	64·9	62·2	66·1	66·6	65·0	65·0
December „	54·0	60·6	61·6	57·4	58·4	54·4	60·0	61·7	57·6	58·4
Year	69·6	72·7	72·7	71·2	71·5	70·0	73·0	73·4	71·7	72·0

The above results are fairly accordant; but it is to be noticed that the excess of the barograph readings noticed in the later months of 1880 has characterised the whole of

the year 1881. The cause of this is now under investigation. The slight differences of the thermometric tables are probably due to the unavoidable differences in the exposure of the instruments.

The readings of the Stewart's actinometer have been made on all clear days, as in the previous year, at *apparent* noon, and two hours before and after; the results, after reduction, will be sent home to the Solar Physics Committee, as were those of the year 1880-81.

The ground temperature observations have been steadily continued, the thermometers being read three times daily, at intervals of 8 hours; and, for one month, the surface and 1-foot thermometers were also read hourly between 5 hours 45 minutes and 21 hours 45 minutes, in order to obtain the curve of the diurnal variation. This series was made in March and April, *i.e.*, at the driest (and nearly the hottest) season of the year, when the diurnal range of temperature is greatest. Similar series will be made in the rainy season and the cold weather. The following table gives the results of the 8-hourly readings of the three thermometers and the monthly means, together with the mean air temperature for comparison:—

Mean temperatures of ground at Alipore in 1881-82.

1881-82.	Surface.			1 foot deep.			3 feet deep.			Means.			
	5¾ hours.	13¾ hours.	21¾ hours.	5¾ hours.	13¾ hours.	21¾ hours.	5¾ hours.	13¾ hours.	21¾ hours.	Air in shade.	Surface.	1 foot.	3 feet.
April	78·9	108·4	82·8	84·8	85·0	86·2	83·2	83·3	83·3	85·3	90·0	85·3	83·3
May	80·7	101·4	83·0	86·7	86 8	87·3	86·1	86·2	86·2	84·1	88·4	86·9	86·2
June	82·6	93·1	83·8	86·3	86·3	86·6	85·9	86·0	86·0	83·4	86·5	86·4	86·0
July	82·4	92·8	83·8	86·2	85·5	86·4	86·4	86·4	86·3	83·0	86·3	86·0	86·4
August	82·3	92·0	83·9	85·3	85·3	85·5	85·6	85·6	85·6	82·5	86·1	85·4	85·6
September	82·5	95·1	84·4	86·0	86·0	86·2	86·2	86·3	86 2	82·9	87·3	86·1	86·2
October	78·2	91·2	80·6	83·3	83·6	83·6	85·5	85·5	85·5	79·7	83·3	83·5	85·5
November	66·1	82·2	70·2	75·8	76·3	76·4	80·9	81·0	80·4	71·9	72·8	76·2	80·8
December	57·6	75·5	61·5	68·3	69·1	69·0	75·3	75·7	75·4	64·2	64·9	68·8	75·5
January	61·0	76·1	64·6	68·8	69·2	69·7	72·9	73·2	73·2	67·1	6,·2	69·2	73·1
February	63·7	81·4	67·7	71·6	71·9	72·4	74·8	74·9	74·9	69·3	70 9	72·0	74·9
March	73·4	99·7	78·3	79·0	79·1	80·1	7[illegible]·8	79·0	79·0	79 4	83·8	79·4	78 9
Means	74·1	90·7	77·1	80·2	80·3	80·8	81·8	81·9	81·8	77·7	80·6	80·4	81·9

This table shows apparent anomalies of the same kind as those noticed in last year's report. The temperature at 3 feet deep is 4·2° in excess of that of the air and 1·5° above that at one foot deep.[1] At Allahabad, Mr. Hill finds similar differences. The cause of these remains to be explained.

[1] It appears from the results of the hourly observations mentioned above in the text that in the months of March and April the mean of the three readings at 8-hour intervals, differs from that of 24 hours by less than 0·1°. The mean of the 24 hours was obtained by interpolating, graphically, the readings for the interval of the night hours between 9 hours 45 minutes P.M. and 5 hours 45 minutes A.M. The mean surface temperature of the 24 hours, similarly obtained, is 0 2° only below that of the three 8-hourly readings.

The number of instruments verified at the Alipore Observatory, during the year ending March 1882, is as follows:—

1. Barometers	22
2. Aneroids	7
3. Dry and wet bulb thermometers	22
4. Maximum thermometers for air temperatures	33
5. Minimum ditto ditto	33
6. Ditto ditto for nocturnal radiation	22
7. Solar radiation thermometers	33
8. Standard thermometers	1
9. Actinometers	3
TOTAL	176

An apparatus for the verification of thermometers (at temperatures above the freezing point) similar in construction to that originally devised and constructed for Kew, was received from England in August 1881. On removing it from its case, it was found to be injured, owing evidently to want of proper precautions in packing; and eventually it had to be taken to pieces and repaired at the Mathematical Instrument Department. It is now in good working order. Two simple contrivances for testing the freezing points of thermometers have been presented to the Observatory by Colonel Tennant, R.E., F.R.S., Mint Master of Calcutta.

The following is a summary of the instruments received and issued by the Observatory Store Department:—

	Received.	Issued.
1. Barometers	32	23
2. Aneroids	4	5
3. Dry and wet bulb thermometers	16	35
4. Maximum thermometers for air temperature	9	23
5. Minimum ditto ditto	16	30
6. Ditto ditto for nocturnal radiation	54	50
7. Standard thermometers	1	1
8. Solar radiation thermometers	58	32
9. Actinometer (Stewart's)	0	1
10. Anemometers	16	23
11. Anemoscopes	1	0
12. Hygrometers (Regnault's)	0	1
13. Sunshine recorders	1	1[1]
14. Apparatus for testing freezing points	2	2[1]
15. Ditto ditto thermometers	1	1[1]
TOTAL	211	228

The consumption of instruments at the different observatories will be shewn in a tabular form in another section of the report.

The time signals were given, during the whole of the year, with the new time ball constructed by Messrs. Varley, and set up on the roof of the Port Commissioner's office. The ball dropped accurately on 279 days. Of the remainder, 76 days were Sundays and public holidays, on which the signals are not given; and on 10 days the

[1] These instruments issued for use in the Alipore Observatory.

signal was either inaccurate or incomplete, or failed entirely—failures which were, in the majority of cases, traceable to some imperfection in the communications. The following is a detailed list of the failures :—

Dates of failure.	Nature of failure.
11th May 1881 . .	Telegraphic communication out of order; ball not hoisted.
10th October „ . .	The ball failed to give the return signal confirming its accuracy.
20th „ „ . .	Ball did not drop at the usual signal.
7th November „ . .	Telegraphic communication out of order ; ball not hoisted.
9th „ „ . .	Ball dropped about 1·5 seconds after 1 P.M.
18th „ „ . .	Ball did not drop at the usual signal.
29th December „ . .	Ball dropped about 36 seconds after 1 P.M.
6th January 1882 . .	Ball did not drop at the usual signal.
7th „ „ . .	Ball dropped about 3 minutes 15·25 seconds before 1 P.M.
27th March „ . .	The ball failed to give the return signal confirming its accuracy.

These failures are less, by three, than in the previous years, the lines of communication being fully a mile longer and the completion of the signal depending on the integrity of two lines instead of one. Moreover, the duty of hoisting the ball and setting the trigger is performed by the servants of the Port Commissioner's Office, not by the more experienced servants of the Telegraph Department.

The service of the old ball on the semaphore tower in Fort William was discontinued on the 1st April 1881. Some delay was incurred in removing the old ball and setting up the new ball and apparatus; (the duplicate of that in use at the Port Commissioners); and the apparatus was not completely set up before the 16th January 1882. Even then it could not be brought into use, pending the completion of a new and direct line of communication between the observatory and the Fort. This was not reported ready until the 27th April, after the close of the year under report, and the service was resumed on the 8th May. The arrangements for firing the gun by electricity were completed still later. In the introduction, I have already detailed some of the causes which have delayed this improvement.

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—During the whole or part of the year there were seven observatories of the second class, eleven of the third class, and three of the fourth class in Bengal and Assam; but, of these, the second class observatory at Dhubri has been substituted for that of Goalpara, which was included in the report for last year; and two of the third class were co-existent at the same station (Darjeeling); the observations being made simultaneously at the new and old observatories, in order to obtain the difference of their average conditions.

Second Class.

Sibsagar.	Patna.	Cuttack.
Dhubri.	Hazaribagh.	Chittagong.
	Saugor Island.	

Third Class.

Darjeeling (E. T. Office).	Gya.	Silchar.
Ditto (St. Paul's School).	Berhampore.	False Point.
Purneah.	Burdwan.	Jessore.
Durbhànga.	Dacca.	

Fourth Class.

Demagiri.	Mongpoo.	Calcutta (Chowringhee).

At stations of the second class, excepting Saugor Island, hourly observations are recorded on four days in each month, and also synoptic observations, which are taken daily at 18h. 1m. Calcutta mean time, for communication to Chief Signal Officer, Washington, as part of the International Series of Synoptic Observations. Full sets of observations are also recorded daily at 10 A.M. aud 4 P.M., as at stations of the third class; and, at Saugor Island, also at 10 P.M. and 4 A.M., in lieu of the hourly observations of the other observatories. At Chittagong and Saugor Island, the wind direction and movement are recorded continuously by Beckley's anemographs. At Hazaribagh, Dhubri, and Cuttack, embossing anemographs of Casella's pattern are in use, that at Dhubri having been set up on a tower erected for the purpose, and brought into use on the 18th March 1882. A similar instrument originally intended for the Patna observatory has been transferred to Darjeeling.

Mr. Eliot's report (Appendix A) states that two of the second-class observatories, *viz.*, Dhubri and Patna, have been inspected during the year, the former by Mr. Eliot himself, the latter by Mr. A. Pedler, who officiated for him during three months of the last cold season. The Dhubri observatory was not completed at the time of his visit, the anemometer tower not having been built. In its imperfect condition it was, however, in very good order. The position is favourable, and the observer is careful in his work. The assistant observer was in charge at the time of inspection, the observer being on leave.

Of the Patna, or rather the Bankipore, observatory, inspected on the 26th February, Mr. Pedler's report, endorsed by Mr. Eliot, is less favourable. Some of the instruments afforded evidence of neglect; and the observer appears to be somewhat careless in his work. Mr. Eliot reported to a somewhat similar effect in the previous year; and he suggests that, if a change for the better does not take place, it may be advisable to reduce Patna to an observatory of the third class. In this suggestion I am disposed to concur; the more so that the site of the observatory has been changed, and the observations are no longer taken under the same conditions of exposure as formerly. In May 1883, the hourly observations of ten complete years will be available, and it may be a question whether a portion of the money now spent on this observatory may not be turned to better account elsewhere.

Of the remaining observatories of this class, Mr. Eliot reports—"The Saugor Island and Cuttack observatories are the best of my second-class observatories, and have worked satisfactorily during the whole year. Dhubri and Chittagong came next in order of merit. Sibsagar is nearly equal to the last two in character, so far as I can judge by the returns. I regret I have been as yet unable to visit that station. The remaining two, Hazaribagh and Patna, are not at present as satisfactory as they ought to be.

Both send in returns with numerous mistakes, and the returns are usually not received until considerably after the proper time; so much so as to occasionally delay the publication of the monthly abstract. I regret to say that I have found it necessary to fine both observers for delay during the past year."

At Darjeeling, a new observatory of the third class has been established at St. Paul's School, on the crest of the Jallapahar ridge, which, after a year's observations shall have been recorded at the new and old sites simultaneously, will supersede the existing observatory at the Electric Telegraph Office. The reasons for this removal were explained in my report for 1880-81 (p. 19). The situation of St. Paul's School, on the crest of the ridge (209 feet higher than the Electric Telegraph Office), is one eminently favourable for wind observations—a point in which, with the exception of Chakrata, the hill observatories are somewhat defective; and the anemograph, originally intended for Patna, has therefore been transferred to this observatory. The site has also a certain historic interest in connection with the meteorological statistics of the station, as it was here that Dr. Joseph Hooker (now Sir J. Hooker) recorded his observations in 1848-49; the house being at that time the residence of the well-known naturalist and ethnologist, Mr. Bryan Hudgson, F.R.S. The observatory was opened on the 1st October 1881, and was visited by Mr. Eliot on the 20th and 21st November. Mr. Eliot does not state specifically the actual condition of the instruments; but his confident assurance that he believes the observations will be of a high order for accuracy and value, sufficiently expresses his satisfaction with its condition.

Three other observatories of this class were inspected during the year by Mr. A. Pedler, *viz.*, Burdwan, Jessore, and Berhampore. Of the first and last of these, the reports are very favourable; as indeed has been the case in previous years; and the observers at both these stations have been selected as recipients of the special allowances, sanctioned last year by Government, for meritorious observers. Mr. Pedler's report on the Jessore observatory is less favourable. The observer, who has been employed in that capacity for many years, and was originally trained in Calcutta, is quite competent to do his work well, but appears to be very careless, and his instruments shewed many indications of neglect.

Of the remaining third-class observatories, Dacca and False Point, both under the care of the Telegraph Masters, are, as judged from the returns, nearly, if not quite, equal to Burdwan and Berhampore. Durbhanga, Gya, and Jessore follow next in order of merit; while the work of the Silchar and Purneah observatories, during the past year, is not at all satisfactory; and the registers sent in from these stations are always open to a suspicion of want of accuracy. Unfortunately, they, and more especially Silchar, are not very readily accessible, and it is now more than three years since this latter observatory was inspected. It is, however, an important station, as representing the climate of Sylhet and Cachar; and an endeavour will be made during the ensuing season to visit it and the other stations in the Assam province, and to introduce the reforms so urgently required.

Of the three observatories of the fourth class, one, Calcutta, (Chowringhee) is attached to the Meteorological Office, and is always under inspection; that of Mongpoo is a voluntary observatory, situated at the Government cinchona plantations below Darjeeling, and is quite trustworthy. The third, at Demagiri in the Chittagong Hill

Tracts, is also a voluntary observatory, of which nothing more can be said than that there appears to be no reason to question the validity of the registers.

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH.—Three additional observatories have been established in these provinces during the past year, by the Meteorological Reporter, Mr. S. A. Hill, B.Sc., all of the third class; and they are now represented by seventeen observatories, classed as follows:—

Second Class.

Allahabad.	Lucknow.
Agra.	Roorkee.

Third Class.

Chakrata.	Dehra.	Benares.
Ranikhet.	Bareilly.	Jhansi.
Mussooree (St. Fidelis)	Meerut.	Pauri.
Ditto (Surveyor General's Office).	Gorakhpur.	Pithoragarh.
	Ghazipur.	

All the observatories of the second class contribute registers of the same character as stations of the same class in Bengal; and Allahabad, which is only provisionally retained in this class, pending the provision of a permanent building for an observatory of the first class (with autographic instruments), furnishes several additional observations. These are, readings of all (except self-registering) instruments, at 4 A.M. and 10 P.M.; making, with the ordinary sets at 10 A.M. and 4 P.M., four sets of observations, at equal intervals of six hours; observations of ground temperature, taken under conditions similar to those at Alipore, at depths of $\frac{1}{2}$ inch, 1 foot, and 3 feet; also the traces of a King's barograph, and an occasional record of the movement of the clouds, by means of a nephescope, similar in pattern to that of the Montsouris observatory.

An abstract of the results of the observations of the ground temperature is given by Mr. Hill, in the Appendix to his report, (Appendix B II), from which it will be seen that, at Allahabad as at Calcutta, the temperature of the ground exceeds that of the air by several degrees, and, moreover, that at 3 feet deep is higher than at 1 foot deep.

As regards the proposed removal of the Allahabad observatory from its present temporary position at the private dwelling-house of the Meteorological Reporter to the site selected for it at the new Muir College, Mr. Hill reports that the building has not yet been commenced. Plans have been drawn and sites chosen, again and again, but still no progress has been made; the last cause of delay being a reference to the English architect who designed the Muir College, and who objected to any addition not designed by himself. Meanwhile, as the present temporary site must be vacated before long, a thermometer shed has been erected near the College, and, from the beginning of the current year, observations have been made there simultaneously with those at the present observatory, in order to shew how the temperature registers will be affected by the removal of the observatory.

Mr. Hill adds—"It is possible that, after all, the first-class observatory may not be erected at Allahabad but at Cawnpore . . . . ."; but, in any case, the

Allahabad observatory will be maintained on its present or a reduced scale, and the temperature comparison, now instituted, will therefore not be lost.

The remaining second-class observatories were all inspected during the year, either by Mr. Hill or by Mr. Boutflower, who temporarily officiated for him. Roorkee was visited in May by Mr. Boutflower, Lucknow by Mr. Hill in June, and Agra in December. No details are given in his report; but it is remarked that "neither I nor Mr. Boutflower found much to complain of in the general condition of the observatories we visited; the instruments being, as a rule, clean and in good order." The error of following Madras (or railway) instead of local time, which, last year, was found to prevail at some of the observatories, has been eradicated.

Lucknow and Roorkee alone are provided with anemographs, both of Beckley's pattern. That at Roorkee is reported to have worked thoroughly well, and the traces of two years now await measurement and tabulation. That at Lucknow had been set up in a very unsuitable position, as was noticed in my report for last year. It has now been removed to the position which I selected for it when visiting the observatory in November 1880; and since the 7th August, 1881, when it was again set to work, it has worked admirably.

The thirteen observatories of the third class furnish registers of the same character as those afforded by the observatories so classed in Bengal, and indeed all other provinces (excepting Madras). Only six were provided with observers, paid by the Meteorological Department. Of the remainder, two are carried on in connection with the offices of the Survey of India at Mussooree and Dehra, respectively, (at the first during the summer season only); a third is established at St. Fidelis' School, Mussooree, at a much lower elevation than the survey office, and the observations are recorded by the masters, under the Rev. Fr. Genesius, S. J., the Principal of the school; a fourth, that of Meerut, is carried on at the expense of the Municipality of that city; a fifth is established in connection with the opium factory at Ghazipur; and the remaining two were established, on the voluntary system, at the Himalayan stations Pauri and Pithoragarh, in June and May 1881, respectively. At the former, the work has been undertaken by the Rev. J. T. McMahon; at the latter by the Rev. Dr. Gray, the instruments being supplied by this Department.

The observatories of Ranikhet, Pauri, Mussooree (St. Fidelis), Chakrata, Bareilly, and Benares were visited, during the year, by either Mr. Hill or Mr. Boutflower, and are subject to the same remark as that quoted above, with reference to the second-class observatories. On the occasion of his visit to Mussooree, Mr. Hill determined the exact elevation of the barometer cistern at St. Fidelis' School, by running a line of evels to a G. T. S. bench-mark, in the immediate neighbourhood. Thus a very limportant datum has been supplied, which was wanting previously.

The observers at the second-class observatories, Allahabad, Agra, and Lucknow, and at the third-class observatories, Chakrata, Ranikhet, and Benares, have been selected for the special allowances recently sanctioned for meritorious work.

Some further details are given in Mr. Hill's report (Appendix B I).

OBSERVATORIES IN THE PUNJAB.—The number of observatories in the Punjab is the same as at the close of the previous year, *viz.*, eleven, all under the Reporter to the

Government of the Punjab, whose Administration Report will be found in Appendix C. They are classed as follows:—

Second Class.

Lahore.

Third Class.

Mooltan.	Rawalpindi.	Simla.
Dera Ismail Khan.	Sialkot.	Delhi.
Peshawar.	Murree.	Sirsa.
	Ludhiana.	

It was originally intended to raise Lahore, as well as Allahabad, to the status of a first-class observatory, provided with autographic instruments; and a Van Rysselberghe meteorograph was obtained from Europe for its equipment. But, in the first place, the position of the existing observatory at the Mayo Hospital is far from suitable, and in the second place it would be useless to set up such an apparatus in the absence of any skilled artisans, or of a superintending officer with practical experience in the use of delicate physical apparatus[1]; and as there is now but little prospect of the services of any such officer or establishment being available in Lahore, the scheme of establishing a first-class observatory at this station has been for the present abandoned; and the Van Rysselberghe has been otherwise disposed of. Lahore, therefore, continues to work as a second-class observatory; furnishing, however, observations at four 6-hourly intervals, on all days, in addition to the hourly observations on four days in each month.

The majority of the Punjab observatories have been inspected twice during the past year. All, with the exception of Dera Ismail Khan and Mooltan, were visited by Dr. Lawrie, the Meteorological Reporter to the Government of the Punjab, in August and September 1881; and, excepting Simla and Lahore, all were again visited by Mr. Eliot, when officiating for me, as Meteorological Reporter to the Government of India, from December 1881 to February of the present year. Mr. Eliot verified the barometers of all the observatories inspected.

Of the Delhi observatory, Dr. Lawrie remarks that, with the exception of a slight error in the construction of the thermometer shed, the insecure fixing of the anemometer, and a few trifling defects which were remedied during his visit, everything was in fair order, and the records were well kept. Mr. Eliot found the thermometers all clean and in good order, with the exception of the nocturnal radiation thermometer, which seemed to be somewhat faulty in action. The wind vane was tested and found to be correctly placed; the anemometer in good order and working fairly, but rather dirty. He reports that the Assistant Surgeon, who is the observer, is intelligent and fully competent. The only points to which it was necessary to direct his attention, were a more careful adjustment of the fiducial point of the barometer and the occasional dusting of the anemometer. A stronger ladder also was required to give access to the anemometer.

At Sirsa Dr. Lawrie "found all the instruments, except the rain-gauge, in good

[1] It will be seen from a remark in Dr. Lawrie's report (Appendix C) that he thinks the meteorograph would probably have been of great service at the Lahore observatory; and in this opinion I should have concurred, could I have thought it probable that it would have worked successfully. But a practical experience of the working of the instrument for some months in my own office at Calcutta has led me to a negative conclusion. In the Maharajah's observatory at Jeypore, where a building has been erected specially for its reception, and where the assistance of skilled artisans is always available, I think this beautiful instrument will be under far more favourable conditions.

order. The anemometer was in a wrong position on the top of the (thermometer) shed," and was directed to be removed to the top of the Jail Office. "The rain-gauge was out of order, and was replaced by a new one," and a number of petty repairs were effected during Dr. Lawrie's visit The thermometer shed was in a "most tumble-down" condition, and was condemned. It appears from Mr. Eliot's report that, at the date of his visit in the beginning of January, the condition of the thermometer shed and wind vane were the same as at the time of Dr. Lawrie's visit. He says, "The observatory shed is very old and certain to tumble down during the first high wind," and "the anemometer and wind vane are placed on the top of the main post of the observatory shed and approached by a ladder, . . . so unsafe, that I was unable to examine the instruments thoroughly." He also condemns the position of the shed as being too near the ice-pit; and he recommends its reconstruction in a neighbouring position, offering a similar exposure, on a site the occupation of which had been sanctioned by the Deputy Commissioner. Dr. Lawrie reports that the shed has since been reconstructed on the site recommended by Mr. Eliot.

The observatory had never before been visited by any Meteorological Officer, and hence probably its somewhat neglected condition. Of the observer, Mr. Eliot reports very favourably. He says, "The thermometers were all clean, well kept, and in good order. The observer reads the instruments carefully and accurately; and when a proper shed has been supplied, I am quite sure the Sirsa observatory will supply accurate and trustworthy observations, and take a high place among our Indian observatories."

At Ludhiana, Dr. Lawrie found all the records, instruments, shed, &c., in good order. The Assistant Surgeon (who is also the observer) is a man of intelligence; but his clock was not going at the time of Dr. Lawrie's visit, and he was unable to explain how, under these conditions, he managed to take his observations punctually. Apparently at the time of Mr. Eliot's visit in December, all causes of complaint had disappeared. The only improvement which Mr. Eliot had to recommend was, that the barometer should be fixed, instead of being allowed to swing freely. Both the instruments and the buildings were in thoroughly good order, and the observer appeared to take the observations intelligently and carefully. His report concludes—"I am perfectly satisfied with the condition of this observatory."

The Simla observatory was visited by Dr. Lawrie, and also by myself during the Simla season. My own experience is to the same effect as Dr. Lawrie's, *viz*, that the instruments are well kept, clean, and in good order. The difference of level between the present site (at Bairdville) and the former site (at Portmore) has been determined by levelling during the past year.

Sialkot was visited by Dr. Lawrie in September, and by Mr. Eliot in December, 1881. The position of the observatory is faulty in some respects, and, at the time of Dr. Lawrie's visit, the ladder for giving access to the wind vane (anemometer?) was in so dangerous a condition as apparently to lead the reporter to entertain some doubt whether it was really used. This appears to have been remedied at the time of Mr. Eliot's inspection. Mr. Eliot found the instruments very clean and in capital order, the barometer well placed and in thoroughly good condition; and the wind vane and anemometer in satisfactory order, clean and well oiled. The rain-gauge appeared to be somewhat injudiciously placed, and the minimum thermometer did not work well, but with

these slight exceptions, everything was satisfactory; and the Assistant Surgeon, who is the observer, is thoroughly and intelligently acquainted with the work of observation.

The reports on the Rawalpindi observatory are much less satisfactory, and the registers for the past year afford indications of serious neglect, in addition to those noticed by the inspecting officers. Dr. Lawrie states, indeed, that the thermometer shed was well built, according to pattern and in good order, but the instruments were neither well kept nor clean. The wind vane stand was also not firm. He adds—"The observer at this station gave much trouble during the year and neglected to maintain accuracy in his observations."

Mr. Eliot found the barometer clean and in good order, but the observer was unable to set and read the instrument properly; the thermometers were, however, in good order Mr. Eliot considers the readings of the barometer, hitherto recorded by this observer as worthless; and this condemnation is borne out by the results of comparison with those of Murree and other stations. Moreover, the readings of the hygrometer from April to August 1881, inclusive, are in great part worthless, as was detected when the registers came into the hands of my own office.

The Murree observatory, on the other hand, is reported on in the most favourable terms. Dr. Lawrie found it, as it invariably is, "in capital order, and all the records and observations kept with great care and neatness." And Mr. Eliot's testimony is to a similar effect: "The observatory shed is capitally placed on the crest of a hill; the thermometers are in thoroughly good order . . .; the barometer is placed in the office room, with a good side light; . . . . the anemometer, wind vane and rain-gauge are all in good order and properly placed. The observatory is altogether in a very satisfactory condition and reflects great credit on the observer [Mr. Johnson succeeded by Mr. Cruikshanks]." very much of this very satisfactory state of things is certainly due to the exertions of the Superintendent, the Reverend Mr Peak, also Principal of the Lawrence Asylum.

The reports on Peshawar are also favourable, as far as they relate to the work of the observer. In the equipment of this observatory, as well of that of many other stations, several matters were found susceptible of improvement. Dr. Lawrie says, "I found the records kept very neatly. The observer has given satisfaction during the year by the accuracy of his observations. I found the shed small and not made according to pattern. The barometer was an old one and kept in the verandah, &c. . . . . A new barometer was supplied and all the defects noticed remedied, except that a new shed has not hitherto been put up."

Mr. Eliot also condemns the shed, and the position of the barometer in the verandah, which is in infraction of the official instructions. The barometer has since been placed inside. He reports: "The instruments are all in very good order, perfectly clean and in satisfactory condition." "Generally, I am thoroughly satisfied with the condition of the observatory; and when the improvements suggested are effected, it will be one of the most valuable observatories in the Punjab. The observer takes the observations accurately and carefully, and records them very neatly."

The observatory of Dera Ismail Khan has never been visited by any reporter before Mr. Eliot's visit, although it is one of the oldest observatories in the Punjab. In the time of the late Meteorological Reporter to the Government of the Punjab, the

only inspection ever attempted was by one of the clerks of his office. It is, therefore, a matter of congratulation that the defects found by Mr. Eliot were only such as indicate a very ordinary degree of neglect. The barometer, an old one, was in fairly good condition; and the observer read it correctly, but with difficulty, owing to the bad illumination. The thermometer shed was very dirty; the instruments generally in order, except that all were covered with dust, and the wet thermometers coated with encrustation. The wind vane and the anemometer were in good order, but dirty. The observer was found to read his instruments quite correctly.

Lastly, the observatory of Mooltan was inspected by Mr. Eliot in December; it was last visited by Dr. Lawrie in 1880; and had also been inspected by Mr. Eliot in January 1879, and by myself in April 1875. It was formerly one of the least satisfactory in the province; but Mr. Eliot's report is generally very favourable, some little details only requiring correction; such as that the barometer was allowed to hang loosely, the solar thermometer was wrongly inclined, the wind vane was not firmly fixed; and it was the practice of the observer to read his thermometers only to whole degrees. The records were in good order and kept up to date; and the condition of the observatory good. The observer was unwell and absent at the time of Mr. Eliot's visit.

As the general result of the inspection, the observatories in the Punjab shew a considerable improvement on the condition presented by them a few years back; but something still remains to be done, and it is only by dint of frequent inspection and careful examination of the registers, that such observatories as that of Rawalpindi can be brought up to the required standard. The practice on the part of the observers, of handing over the work to one of their subordinates, to which Dr. Lawrie has drawn attention, both in the present and in last year's report, is, no doubt, the cause of much bad work; but this practice will not be suppressed by increasing the allowance to the observers; nor, I fear, will the character of the work be materially inproved by requiring them to certify that the readings have been recorded by themselves personally. The latter measure, in so far as it may tend to the suppression of vicarious work by untrained subordinates, will, probably, only foster unpunctuality and therefore inaccuracy. The fundamental error appears to me to be in the system adopted in the Punjab, which requires the observations to be registered by men, who practise privately for remuneration, and whose personal interests therefore are likely to clash with the requirements of the work. Increasing the allowances of such men will not induce them to sacrifice any of their private practice; and the remedy is to be found in entrusting the work to men who have no such direct inducement to neglect it. But no measures of this kind are likely to be successful unless the observatories are frequently inspected; and unless the Meteorological Reporter works personally at the data sent in by his observatories, thus placing himself in a position to detect inconsistencies and physical impossibilities. Under Dr. Lawrie's superintendence,—that is, during the last two years,—the Punjab observatories have been assiduously visited; but there is but too much reason to believe that the meteorological work of the Punjab observatories has not always received that amount of attention on the part of the local reporter, that was indispensable to keep the observers up to the work; and the observatories are still suffering in some measure from this past neglect. It will be the work of time and assiduous attention on the part of the controlling officer to place matters on a healthy footing; some changes of system may be found necessary; but the favour-

able reports of many of the observatories contributed by Mr. Eliot shew that no sweeping changes are necessary, and that if much remains to do, much has already been done.

The nominal list of superintendents and observers at the Punjab observatories is given in the return appended to Dr Lawrie's report (Appendix C II). The observers at Peshâwar, Mooltan, and Sirsa have been selected for the special allowances granted for meritorious work.

OBSERVATORIES IN THE CENTRAL PROVINCES.—These are eleven in number, as in previous years, *viz.*, three stations of the second class and eight of the third class :—

Second Class.

Nagpur. | Jubbulpore. | Pachmarhi.

Third Class.

Saugor.	Chanda.
Hoshangabad.	Sironcha.
Seoni	Raipur.
Khandwa.	Sambalpur.

The detailed report on the condition of the observatories in the Central Provinces, drawn up by Dr. B. Simpson, the Deputy Surgeon General of the Province, will be found *in extenso* in Appendix D.

The work of the Nagpur and Pachmarhi observatories has been satisfactory. Nagpur is the only observatory that has been inspected by the Deputy Surgeon General, who, in conjunction with the Meteorological Reporter for India, administers the meteorological work of the province; and this was found to be in the same excellent condition as at the time of my own inspection in the spring of 1880.

The objectionable proximity of the new anemograph tower to the old platform on which are set up the wind vane and small anemometer, noticed in Dr. Simpson's report, has the effect of rendering of little value the indications of the two latter instruments, which is to be regretted, as it was intended that they should be recorded together with those of the Beckley's anemograph on the summit of the tower, in order to ascertain their comparative values. This object has, of course, been sacrificed. But the anemometric data for the observatory are now taken solely from the anemograph, and this is in no way prejudically affected.

The Jubbulpore observatory has been very assiduously superintended by the Superintendent, Dr. Rice, but he has had much trouble with the observers. One of them resigned on the 28th February 1882, and he was succeeded by a clerk of the Bengal Meteorological Office, who had applied for the post, and, after being trained at Alipore, was sent up to Jubbulpore. He is reported to have worked most unsatisfactorily, pleading illness as the cause; but this plea is not confirmed by the Civil Surgeon. At the close of the year arrangements were being made for replacing him.

A Casella's embossing anemograph has been set up at Jubbulpore on the summit of the tower of the civil branch dispensary, an excellent position, in which, if anywhere, in the interior of India, it should work well. It has, however, been necessary to lengthen the driving chains of the instrument, and some delay was incurred in procuring chain suitable for this purpose. The barometer, hitherto kept in the Central Jail, was removed to a lower room in the same building, on the morning of the 8th April 1881. The present position is 10 feet higher than that which it formerly occupied. The thermometer shed,

together with the old wind vane and anemometer, are apparently retained in their old position on the *maidan* in front of the jail.

Of the third class stations, Saugor has been very unsatisfactory. The observer has repeatedly sent in imaginary readings of the barometer, which, when laid down on the daily charts, were at once detected as false, by their discrepancy with those of other stations around. After repeated warning and fining, as he was found persistently to recur to this practice, it was resolved to dismiss him, and accordingly he was dismissed, shortly after the close of the year under report. The position of the wind vane and anemometer at this observatory has been greatly improved by the erection of a mast, the top of which is made accessible by a ladder.

With this exception, the work of the third-class stations in the Central Provinces has been generally satisfactory; and the observers at Nagpur, Hoshangabad, Chanda, and Sambalpur have been selected for the special allowances recently sanctioned by Government. The names of all superintendents and observers, who have officiated during the year, are given in the return appended to Dr. Simpson's report (Appendix D II).

OBSERVATORIES IN BERAR.—There are five of these—as in the previous year, one, *viz.*, Makhla—being established in connection with the Forest Department, and working as a fourth-class observatory. It contributes its registers to the Meteorological Office, Calcutta. The remainder are under the direction of the Meteorological Reporter for Western India, in conjunction with the Sanitary Commissioner for Berar. They are—

Third Class.

Akola.	Chikalda.
Buldana.	Amraoti.

Fourth Class.

Makhla.

None of these observatories have been inspected during the year, but, as judged by the registers, they appear to have worked well. The observations of the nocturnal radiation thermometer at Chikalda have alone been rejected as untrustworthy. The observers at Akola and Amraoti have been selected for the special allowances recently sanctioned. The names of all superintendents and observers, at the four third-class observatories, are given in the Appendix to Mr. Chambers's Report (Appendix E II).

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—The number of these observatories is the same as at the beginning of the year, *viz.*, one of the second and nine of the third class, as follows:—

Second Class.

Jeypore.

Third Class.

Sutna.	Indore.	Ajmere.
Nowgong.	Mount Abu.	Sambhar.
Neemuch.	Pachbudra.	Bickaneer.

The observatory at Jeypore, founded and supported by the Maharajah of that State, has contributed a very valuable register during the past year; the work being carried on on the same system as at Allahabad, and comprising daily observations at six-hourly

intervals (4h. and 10h. A.M. and P.M.), hourly readings of all the instruments on four days in each month, synoptic observations daily for the Washington Chief Signal Office; and observations of the temperature of the ground at various depths down to 20 feet. The results of all these are very liberally placed at the disposal of this office, and a daily weather telegram is transmitted to the Meteorological Office as from the observatories established by this Department.

During the past year, the Superintendent, Dr. T. H. Hendley, applied to me for assistance in procuring a Van Rysselberghe's meteorograph for the Jeypore observatory, in order that it might be raised to a first-class observatory. As, at this time, the instrument procured for Lahore was lying unused at Calcutta, and, as already stated, there appeared to be little prospect of its being usefully set up at that station, it was, with the sanction of Government, placed at the disposal of the Maharajah, who accordingly purchased it, and had a building specially constructed for its reception. At the close of the year, it was about to be fixed in position.

A memorandum on the Jeypore observatory, by Dr. T. H. Hendley, is appended to Mr. Hill's report (Appendix B I).

Of the third-class observatories, Sutna, Nowgong, Ajmere, and Sambhar now communicate their registers to Mr. S. A. Hill, the Meteorological Reporter to the Government of the North-Western Provinces and Oudh; Neemuch, Indore, Mount Abu, and Bickaneer, to the Meteorological Reporter for Western India; and Pachbudra sends them direct to the Calcutta Meteorological Office.

Sutna, Jeypore, Ajmere, and Sambhar were all visited by Mr. Hill during the year. Of Sutna, he says, everything was in good order, excepting a Casella's anemograph that had been recently set up. This instrument, he reports, has not given traces of any value. "It would probably work very fairly in England, or at a sea-coast station in India; but for the interior of the country, it has the fatal defect of depending on the movement of the wind to carry forward the recording paper. Consequently, at night, when light winds and calms prevail, the hammer which embosses the direction mark comes down hour after hour on the same spot, and 24 distinct impressions are hardly ever obtained in twenty-four hours." This opinion of the comparative unfitness of the Casella's anemograph for the interior of India, where the wind movement is frequently very low, is perfectly just. But it has been found that at the inland station, Cuttack, very useful registers are obtained from a precisely similar instrument, by the simple expedient of marking in ink the 10 h. and 16 h. impressions of the die. Reading backwards and forwards from these, it but rarely happens that there is any difficulty in measuring off and tabulating the wind movement and direction throughout the day.

On the other third-class stations visited, Mr. Hill offers no special remark. The names of the superintendents and observers at the stations on his list are given in the appendix to his report. The observer of Sutna, Harnath, has had one of the special allowances conferred on him for meritorious work.

Of the four observatories that report to Mr. F. Chambers, none has been inspected during the year. It will be seen in the list of defective observations, given in Mr. Chambers's report (Appendix E), that at Mount Abu, for some days in April, and again from the middle of October to the end of the year, the barometric observations appear to be untrustworthy. Moreover, from the 16th June to the 14th October no

observation were recorded, and the same from the 8th February to the 18th March. Thus the observatory of Mount Abu has furnished trustworthy registers for only one or two months of the year. It will be seen that similar vexatious interruptions have occurred at several observatories in Bombay, and I reserve my remarks on this subject until the latter have been also noticed. The registers received from Bickaneer, Neemuch, and Indore seem to have been satisfactory in all respects. Special allowances have been awarded to the observers of Bickaneer and Neemuch.

The registers of Pachbudra have been in some respects very unsatisfactory; the readings of the solar radiation thermometer throughout the year are evidently worthless. Equally so are those of all the minimum thermometers during the later months of 1881 and the earlier months of 1882; and it is obvious that there is much want of intelligence on the part of the observer, combined, apparently, with a considerable amount of negligence of the instructions furnished for his guidance.

OBSERVATORIES IN THE BOMBAY PRESIDENCY.—The number of observatories in Bombay has been the same as during the previous year, *viz.*, fourteen; one of which, Colaba, is independent of the Department; and one, Karwar, is a voluntary observatory, only the instruments being furnished by the Department. They are as follows:—

First Class.

Colaba observatory (Bombay).

Second Class.

Belgaum.	Deesa.
Poona.	Kurrachee.

Third Class.

Jacobabad.	Rajkot.	Ratnagiri.
Hyderabad.	Surat.	Karwar.
Bhuj.	Sholapur.	Malegaon.

Mr. Chambers has not inspected any of the observatories under his administration during the past year. The reason assigned for this is, that the working of the new storm-signal service had kept him in Bombay; and no arrangement had been made for carrying on this work during his absence on inspection duty. This result is, I think, very much to be regretted. The reason offered, although no doubt *bonâ fidè*, is one which, judging from the experience of the Bengal office, where, for many years, a storm-warning system has been steadily carried on, should not have been an insuperable obstacle to the performance of this very essential part of the reporter's duties. The difficulty was first reported in January 1882; but as I was absent on leave, the matter was allowed to stand over until my return in March; it was then at once brought before the notice of Government, and the obvious suggestion that, during the reporter's absence, the administration of the storm-warning system should be carried on by the very competent resident meteorologist, the Superintendent of the Colaba observatory, was approved and carried out by the orders of the Government of Bombay.

As will be seen from the tabular statement in para. 13 of Mr. Chambers's report, the registers at several of the observatories have been subject to interruptions, more or less prolonged, owing to the sickness of the observers or their absence on military duty; chiefly to the latter; and, in addition to the instances enumerated by Mr. Chambers,

was a very vexatious interruption of the Poona registers and telegraphic reports for several days in July, owing, as was reported at the time, to the observer's indulging in a drinking bout, and thereby incapacitating himself for his duty. As it is only in Bombay and Rajputana—and in these provinces only at stations at which either soldiers or assistants in military hospitals are employed as observers—that these interruptions are at all common, it is evidently desirable that civilians should be substituted for persons subject to military rules; and, accordingly, the Reporter for Western India has lately been requested to make preliminary enquiries, with a view to such a change of system.

In paragraph 20 of his report, Mr. Chambers has given a list of the observatories, which have been struck out of the registers as untrustworthy. Among the Bombay stations, Jacobabad, Kurrachee, Deesa, Rajkot, Poona, Ratnagiri, and Belgaum have furnished uniformly good registers. The defective work at Hyderabad, Surat, Malegaon, and Sholapur is attributed to the observers being new and untrained. At Hyderabad, owing partly to the absence of the observers, partly to their incapacity when present, the registers have been more particularly defective; and this station must rank with Mount Abu as very unsatisfactory.

The names of the superintendents and observers at the several observatories in Bombay, as well as those in Rajputana, Central India, and Berar that are administered by the Meteorological Reporter for Western India, are given in the appendix to Mr. F. Chambers's report (Appendix E II). The special allowances, lately sanctioned, have been awarded to the observers at Belgaum, Bhuj, Surat, and Ratnagiri.

OBSERVATORIES IN MADRAS, MYSORE, AND HYDERABAD.—There has been no change in the number of observatories in these provinces during the last year, except that the Ootacamund observatory ceased to contribute registers in March 1881, thus reducing the total to fifteen after that date. The Wellington observatory is, however, now working satisfactorily, so that the Nilgiris are not left unrepresented. Of the following stations, one, Vizagapatam, is a private observatory, established by Mr. A. V. Nursingrow, to whom the office is indebted for the communication of full registers of four observations daily, and also for daily telegrams of the weather and such other information. The others were all working as third-class stations, up to December 1881, when Trichinopoly and Bellary were at length raised to the status of second-class stations, as originally intended:—

Second Class.

Vizagapatam.	Bellary.	Trichinopoly.

Third Class.

Madras.	Salem.	Bangalore.
Madura.	Negapatam.	Secunderabad.
Coimbatore.	Cochin.	Masulipatam.
Wellington.	Mangalore.	Mercara.

With the exception of Vizagapatam, all the above observatories are now under the immediate administration of the Meteorological Reporter to the Government of Madras. In December 1881, those of Mangalore and Mercara, which had been established by the Meteorological Reporter to the Government of India, and, up to that time, had sent their registers direct to the Central office in Calcutta, were transferred to the Madras office.

In Appendix F, is given the very interesting and comprehensive report of the Meteorological Reporter, Miss Pogson, who was appointed by the Government of Madras to the charge of the Meteorological establishments in the Presidency and took over charge of the Meteorological office on the 25th July 1881. This is the first general report that has ever been received on the working of the Madras Meteorological office, since its establishment; and the detailed description which it gives of the position of the observatories and their history is a very useful introduction to the remarks on their present condition.

Miss Pogson has not personally inspected any of the observatories under her charge during the year; but four of the observatories in the above list, *viz.*, Secunderabad, Bangalore, Negapatam, and Madura, were inspected by Mr. Eliot, when officiating as Meteorological Reporter to the Government of India, in January 1882. On Secunderabad Mr. Eliot's report is very unfavourable. "The instruments were generally very dirty, the wet bulbs were covered with a thickish encrustation, and the remaining thermometers more or less coated with dust. The grass radiation thermometer, although in use, was quite out of order, three separate portions being detached from the main column. The support of the wind vane is several degrees out of the vertical; the anemometer is quite loosely attached to its wooden base; there is no receptacle for the rainfall in the rain-gauge. Altogether the condition of the observatory was most unsatisfactory." Further, "the observer is quite unable to read the anemometer, and the previous wind returns are worthless." "I am quite convinced, in my own mind, that he has not taken the observations accurately, at the hours laid down by the Madras Reporter;" and finally, he sums up the results with the remark, "under these circumstances it appears to me that the observations of this observatory are of little or no value."

That Secunderabad has always been a very unsatisfactory observatory, I had some reason to believe, from the consideration of the telegraphic reports and from such waifs of information as have reached me from time to time. But Mr. Eliot's report shows that it was far worse than I had imagined; and it affords a warning example of the condition into which Meteorological observatories in India are likely to fall, when not under the charge of an officer specially interested in the work, or when not kept up to the mark by frequent inspection. The observer, in charge, at the time of Mr Eliot's visit, has since been removed; and, as far as the daily reports admit of an opinion being formed, the work of the observatory appears to be much improved.

Bangalore, and indeed all the remaining observatories; are more favourably reported on. Of this observatory Mr. Eliot says, "The barometer is well placed and in good order. The shed is in very fair condition and the instruments properly placed and in good order, except the wet bulb, which was covered with a slight encrustation." The wind vane and anemometer were very dirty and required cleaning, but the remaining instruments were in good order; and the observer is reported as doing his work carefully, accurately, and neatly."

The report on the Negapatam observatory is uniformly favourable. "The shed is well placed, open in all directions and in good order. The various instruments are all clean and in perfectly good order. The observer takes the observations accurately and intelligently. The condition of the observatory is very satisfactory and creditable to the observer."

Lastly, on the Madura observatory, Mr. Eliot reports: "The shed and instruments are generally in good condition and properly placed." The site was rather too much shut in by trees and shrubs, and Mr. Eliot recommended their partial clearance; also that the barometer be changed, as the mercury required cleaning. But he concludes—"I am quite satisfied with the condition of the observatory. The observer, I may add, takes the observations accurately, and his records appear to be in good order."

Miss Pogson's report on the working of the majority of the remaining observatories is very favourable. Partial exceptions are, however, furnished by Trichinopoly, Masulipatam, and Salem, where the observers do not give satisfaction in reducing and correcting their readings, and forwarding the complete registers, with due promptitude, to the Madras office. The second-class observatory, Trichinopoly, is in this respect most unsatisfactory.

The report acknowledges, with special thanks, the assistance given by the Medica officers in charge of the several observatories; their names, together with those of the observers at each station, are given in the list appended to the report.

There has been much improvement in the communication of the registers of the Madras stations to my office; and the Meteorological Report for 1880, lately issued, is complete in the registers of the Madras stations, as well as in those of other parts of India.

OBSERVATORIES IN BRITISH BURMAH.—Of the eight observatories in British Burmah, one, Akyab, has always been under the direction of the Meteorological Reporter to the Government of Bengal, and is enumerated with the Bengal stations in his report. Another, Diamond Island, was established for the especial purpose of storm warnings, and sends a daily telegram to the Bengal office, and also to Simla during the season. But the registers, as well as those of the remaining Burmese stations, are dealt with in my own office. The remaining stations are under the immediate direction of the Sanitary Commissioner of British Burmah. The following is a list:—

Second Class.

Rangoon.

Third Class.

Bassein.	Akyab.	Moulmein.
Diamond Island.	Thyetmio.	Mergui.
	Tounghoo.	

A list of the superintendents and observers, at the six stations under the Sanitary Commissioner, is given in Appendix G; that of the Akyab observer in Mr. Eliot's report (Appendix A).

I have no report from the Sanitary Commissioner on the condition of the Burmese observatories, and none have been inspected by myself or other Meteorological officer during the year. As judged by the registers, they appear to have worked well, with the exception of the Rangoon observatory, the registers of which have been sent in full of errors, due to carelessness in the reductions, and Tounghoo, at which station, up to the end of June, one of the minimum thermometers was evidently out of order—a fact which implies carelessness and inattention to the printed instructions. Special allowances have been awarded to the observers of Moulmein and Bassein.

OBSERVATORIES AT THE BAY ISLANDS.—Of these there are two as in former years, both of the third class ; they are—

Third Class.

Port Blair (Andamans). | Nancowry (Nicobars).

The list of superintendents and observers during the year 1881-82 is given in Appendix H. The observer at Port Blair has received a special allowance for long and approved service. The registers received from both observatories have been satisfactory.

EXTRA INDIAN OBSERVATORIES.—The only addition that has been made to the list of extra Indian observatories given in last year's report, has been that established on Amini Divi in the Lakadives, and this was established in September 1880; but I have only lately received any report of the fact, and it was not noticed in last year's report. I have as yet no registers. On the other hand, the very important observatory of Gilgit in the extreme north of Cashmere has, I regret to say, been relinquished, owing to the withdrawal of the British Resident. The total number of observatories was therefore the same, at the end of the year under report, as were noticed in the report for 1880-81. But Zanzibar has been raised to the status of a second-class observatory. The list therefore stands as follows :—

Second Class.

Leh. | Aden. | Zanzibar.

Third Class.

Bushire. | Katmandu.
Quetta. | Amini Divi.
Gilgit.

And one foreign observatory in the peninsula, *viz.*, Goa, the Director of which, Senor Antonio Martius, communicates half-yearly registers to this Department and also a daily weather telegram.

The observatory at Aden was visited by myself on the 14th December last, during the stay of the mail steamer, in which I was proceeding to England. The observatory was in the same position, in which it had been at the time of Mr. Eliot's visit in the previous year, *viz.*, at the house of the First Assistant Political Resident, Captain Hunter. Excepting that the minimum thermometer had a break in the column; that the sun thermometer had been injured in transport, and the nocturnal radiation thermometer had about 3° of the spirit column lodged at the upper end of the tube, the instruments were all in good order. The latter instrument had been thus defective for about two months, and the readings for that period must therefore be rejected. The sun thermometer readings, too, must be open to doubt, as the black coating of the bulb had been partly removed in transit, and one of the brass supports was broken and lying in fragments inside the vacuum tube. Moreover, the vibration of the stand, on which it was supported, was such that, in any case, the readings must be open to some doubt.

The Leh observatory has been very carefully superintended by Mr. Ney Elias, the British Joint Commissioner. In discussing the temperatures recorded in past years, and comparing the maximum self-registered temperatures with the reading of the standard thermometer, the former appeared in many cases so excessive, as to be highly improbable. Accordingly, Mr. Elias carefully examined the action of the instruments and detected a

peculiarity in that of the maximum thermometer which fully explained the observed discrepancy, although its cause is still somewhat obscure. The instrument is one of Negretti and Zambra's patents, in which the column breaks at a constriction above the bulb. In the early morning, the instrument was found to agree well with the standard, but about 10 o'clock the column moved forward up the tube, and during the later hours marked a temperature many degrees too high. The cause of this pecu liar action, as I have already remarked, has not been fully explained., But it results that no dependence can be placed on the maximum temperatures recorded at Leh with this instrument.

The work of this observatory, as far as it depends on the observers, has been as satisfactory as in former years, and a special allowance has been conferred on the assistant observer, Bhola, whose excellent work in Yarkand has been prominently noticed in the Indian Meteorological Memoirs; also temporarily on the observer, whose duties at Leh are now nearly at an end.

The observatory at Zanzibar has been admirably conducted by Dr. Robb, who received charge of it from Dr. Peters a few days after the beginning of the year; and who, up to the end of the year, recorded the observations himself. A paid observer was appointed on the 1st January 1882, and the observatory now records synoptic observations, in addition to those of 10h. and 16h.

The observatory at Bushire has no paid observer; but the register is carefully supervised by the Resident, Colonel Ross, the observations being recorded by an employé in the Residency office.

The registers of Quetta have been more satisfactory during the latter part of the year than at the beginning. In July 1881, it was reported by an officer of the Topographical Survey who had occasion to make use of the barometric registers, that the observations were being recorded according to Madras time, which differs from the local time by nearly one hour. This practice, which is in direct violation of the rules laid down and emphasized for the guidance of the observer, was stopped at once, but all past registers are to some extent vitiated by the consequences of the negligent disregard of the rules.

The Katmandu observatory has yielded fairly good work during the past year.

The Amini Divi (Lakadives) observatory began work in September 1880, but no report had been received of this fact until quite recently, and no registers have yet reached me. The observer was trained at Madras and is said to be intelligent and anxious to undertake the duties. As the observer, who is also the hospital assistant, has to go on circuit for several weeks together, there are, unfortunately, frequent interruptions in the registers. Moreover, he was away on privilege leave for 3 months, and as no substitute could be found to carry on the observations, another break has been caused by his absence. When the registers have been received and the results compared, I shall be in a position to say whether it would not be advisable to appoint a special observer on a higher rate of pay, as suggested by Miss Pogson in her report.

The Gilgit observatory was closed on the 8th July, owing to the departure of the Resident and his establishment.

RAINGAUGE STATIONS.—The stations which record rainfall only, communicate their registers to the Meteorological Reporters of Bengal, the North-Western Provinces,

and to the Government Astronomer, who was formerly Reporter for Madras; and the returns are published by them, weekly or monthly, in the local Gazettes. In other provinces, they are either under the Revenue Boards or the Sanitary Commissioners; and the returns are in most cases published in a similar manner. From the whole a selection has been made, chiefly those of the sudder stations, or the seats of political agencies, and these, with the addition of 23 contributed by the Residents of Hyderabad and Mysore, together with a few from private observers, and amounting to 307 in all (exclusive of the regular observatories), are given in the Annual Report, in conjunction with those furnished by the observatories.

During the past year, some additions have been made to the list of the rain-gauge stations, some of the more important of which have been enumerated at page 3.

Mr. Hill has also established rain-gauges at three of the pilgrim dispensaries in Garhwal, all near the snows, and in a region from which the returns of the atmospheric precipitation, hitherto, have been very scanty. And Dr. Hendley has lately undertaken to establish some additional registers in the dry region of Western Rajputana. The rain-gauges, established by the Commissioner of Cuttack in the Tributary Mehals of Cuttack, have contributed registers during the past year, for this hitherto unrepresented hill tract.

Steps have been taken, by the Government of the North-Western Provinces, to supply trustworthy gauges to the sudder stations in each district; a step the necessity for which was shewn in Mr. Hill's report of last year.

In Bombay, Symon's gauges were supplied to all stations in 1877.

OBSERVATIONS AT SEA.—Some steps were taken to extend the system of marine meteorology during the past year. Mr. Eliot has collected the observations taken on board the light-vessels stationed off the mouth of the river, and has received meteorological extracts from the logs of several vessels entering the port, which he obtained through the kind assistance of Mr. S. R. Elson, Master Pilot, and also of the captains of several vessels; many of whom, he reports, appear to be ready and willing to give any assistance in their power to the Meteorological Department.

Under the sanction of the Government of India, a special department has now been organised in this office, under the charge of Mr. Eliot, which will undertake to collect in a more systematic manner, such information on the subject of the weather at sea, as the Masters of ships visiting the ports may be able and willing to furnish from their log books. And special forms of weather logs have been prepared for the use of such as may be willing to keep a regular register for the office. These arrangements did not, however, come into operation before the close of the year under report, and they will be noticed at length in the Administration Report for the year now current.

Mr. F. Chambers has collected a number of registers relating to a severe cyclone which crossed the Arabian Sea between May 27th and June 3rd, 1881, but which was not felt at Bombay.

INSTRUMENTS.

The following is a return of the Instruments in store at the beginning of the year, and of those received and issued by the Calcutta Meteorological office, which is the general

depôt for all India; this list includes the stock, receipts, and issues of the Alipore observatory.

Return of the Stock and Issue of Instruments for the year 1881-82.

Instruments.	In store on 1st April 1881.	Received 1881-82.	Issued 1881-82.	Remarks.
Van Rysselberghe's Meteorographs	2	...	1	Sold to the Maharajah of Jeypore.
Barometers, Observatory, Fortin's Principle	4	11	3	
Ditto, ditto, Kew ditto	2	5	4	
Ditto, Mountain portable tripod (Adie)	19	10	7	
Ditto, Marine K. P.	14	12	...	
Ditto, ditto Fitzroy	7	...	7	Returned to Mathematical Instrument Department.
Ditto, Adie's large standard	6	...	6	
Ditto, Newman's ditto	2	...	...	
Ditto, ditto small ditto	5	...	1	
Ditto, Negretti and Zambra's (various)	16	1	3	
Aneroids	19	...	...	
Thermometers, standard, with attached scales	20	1	...	
Ditto, ditto, without attached scales	1	...	...	
Ditto for hygrometers (Kew pattern)	112	16	35	
Ditto, maximum for shade	142	11	20	
Ditto, minimum ditto	82	16	33	
Ditto, ditto radiation	9	52	49	
Ditto, solar in vacuo	35	58	46	
Pouillet's pyrheliometer	1	...	...	
Stewart's actinometers	2	...	1	
Hodgkinson's ditto	2	...	...	
Herschell's ditto	1	...	...	
Regnault's hygrometers	4	..	1	
Daniell's ditto	10	...	...	
Halleur's ditto	5	..	...	
Boiling-point thermometers	6	..	...	
Pocket spectrescopes (Browning's)	2	..	...	
Wind vanes	21	1	2	
Anemometers	22	12	23	
Rain-gauges (Symon's and Glaisher's)	6	21	6	
Spare measure glasses for ditto	7	...	6	
Hutchins' rain-gauge	...	1	1	
Reading lenses	6	...	1	
Sun thermometer stands	35	...	11	
Radiation pads	13	...	10	

Return of the Stock and Issue of Instruments for the year 1881-82.—Concluded.

Instruments.	In store on 1st April 1881.	Received 1881-82.	Issued 1881-82.	Remarks.
Thermometer cages	5	1	4	
Prismatic compass	1	...	...	
Magnetic ditto (common)	...	1	1	
Sand glasses (3 minutes)	4	25	...	
Sundials (universal)	...	3	3	
Photographic dishes	...	6	6	
Glass tubing	...	10 lbs.	10 lbs.	Issued to Alipore observatory.
Aspirator	...	1	1	
Chain for Casella's anemograph	...	50 ft.	35 ft.	
Apparatus for verifying thermometers	...	1	1	Ditto ditto.
Glass disc for nephescope	...	1	1	
Watches	...	2	2	
Arithmometer	...	1	1	Issued to Office.
Planimeter	...	1	1	
Spirit levels	...	2	2	
Sunshine recorders	...	3	2	1 to Alipore observatory.
Bull's-eye lanterns	1	2	2	
Salinometers	41	...	1	
Common thermometers, brass scales	33	...	...	
Clocks	...	21	18	

The following table, in which is incorporated the lists received from the Local Reporters, shews the instruments that have been issued to each observatory during the year :—

Return of the Instruments issued to Meteorological Observatories in 1881-82.

Provinces.	Stations.	Barometers.	Hygrometers. Dry.	Hygrometers. Wet.	Dry maximum.	Minimum thermometers. Dry.	Minimum thermometers. Wet.	Radiation thermometers. Solar.	Radiation thermometers. Grass.	Anemometers.	Wind vanes.	Rain-gauges.	Measure glasses for rain-gauge.	Standard thermometers.	Lenses.	Lanterns.	Clocks.	Sun thermometer stands.	Woollen pad for grass radiation thermometer.	Thermometer cages.	Remarks.
Punjab.	Mooltan	...	...	...	...	...	..	...	...	1	1	...	...	...	...	...	1	...	...	..	
	Dehra Ismail Khan	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	..	.	
	Peshawar	1	...	...	...	...	...	...	...	...	...	...	...	...	...	..	..	...	...	..	
	Murree	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	..	...	
	Rawalpindi	...	...	...	...	...	...	1	1	...	...	...	...	...	..	..	1	..	..	...	
	Sialkot	...	...	...	...	1	...	...	..	...	...	..	...	...	...	...	.	...	.		
	Lahore	...	...	...	...	...	...	1	...	...	...	...	..	...	...	.	2*	...	..	.	* Watches.
	Ludhiana	...	...	...	...	...	...	...	...	...	...	..	..	...	..	.	1	..	...	...	
	Simla	...	...	...	...	...	...	...	2	..	...	...	...	...	...	..	..	..	...	..	
	Sirsa	...	...	...	...	...	...	...	1	1	..	1	..	...	.		1		..		

Return of the Instruments issued to Meteorological Observatories in 1881-82.—continued.

Provinces.	Stations.	Barometers.	Hygrometers.			Minimum thermometers.		Radiation thermometers.		Anemometers.	Wind vanes.	Rain-gauges.	Measure glasses for rain-gauges.	Standard thermometers.	Lenses.	Lanterns.	Clocks.	Sun thermometer stands.	Woollen pad for grass radiation thermometers.	Thermometer cages.	Remarks.
			Dry.	Wet.	Dry maximum.	Dry.	Wet.	Solar.	Grass.												
North-Western Provinces.	Chakrata	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	1	...	...	...	
	Bareilly	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	
	Agra	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	Gorakhpur	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	
	Jhansi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	
	Allahabad	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	Ghazipur	...	...	...	...	1	...	...	1	1	...	...	...	...	...	...	...	...	...	...	
	Benares	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	Pauri	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Pithoragarh	...	...	...	...	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	* Broken in transit.
Bengal and Assam.	Sibsagar	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	
	Dhubri	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1	...	
	Silchar	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	
	Darjeeling	2	1	1	1	1	1	2	1	...	...	1	1	...	...	...	...	1	...	1	Original furniture.
	Purneah	...	...	...	1	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	
	Patna	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Hazaribagh	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	
	Berhampore	...	...	...	...	...	1	1	1	...	...	...	...	...	1	...	...	...	1	...	
	Burdwan	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	
	Jessore	...	...	...	...	...	...	1	...	1	...	1	...	...	...	...	...	...	1	...	
	Chittagong	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	2	...	
	Saugor Island	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	
	Cuttack	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	False Point	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	
Central Provinces.	Raipur	2	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	Nagpur	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	
	Seoni	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	
	Pachmarhi	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	
	Chanda	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
Berars.	Chikalda	1	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	
	Akola	...	...	...	...	...	...	...	...	...	...	1	2	...	...	...	...	...	...	...	
	Amraoti	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
Central India and Rajputana.	Neemuch	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	Nowgong	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	...	...	...	...	...	† Broken in transit.
	Indore	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	Bickaneer	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
	Ajmere	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	1	...	...	...	
	Mount Abu	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	

Return of the Instruments issued to Meteorological Observatories in 1881-82.—concluded

Provinces.	Stations.	Barometers.	Hygrometers. Dry.	Hygrometers. Wet.	Dry maximum.	Minimum thermometers. Dry.	Minimum thermometers. Wet.	Radiation thermometers. Solar.	Radiation thermometers. Grass.	Anemometers.	Wind vanes.	Rain-gauges.	Measure glasses for rain-gauges.	Standard thermometers.	Lenses.	Lanterns.	Clocks.	Sun thermometer stands.	Woolln pad r. grass radiation thermometer.	Thermometer cages.	Remarks
Bombay.	Hyderabad	1	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	..	..	
	Kurrachee	...	...	...	...	...	...	...	...	1	...	..	...	...	...	...	...	...	...	..	
	Bhuj	...	...	...	...	...	..	1	1	...	...	...	...	...	...	...	...	...	...		
	Rajkot	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	..	
	Deesa	...	...	...	...	...	...	...	1	...	...	...	.	...	...	...	...	...	...		
	Surat	...	...	...	...	...	...	...	2	..	...	..	...	..	...	...	...	...	..	...	
	Malegaon	1	...	...	...	...	...	1	...	...	...	...	..	...	...	...	...	...	...	.	
	Poona	...	...	...	...	...	...	...	1	...	...	..	...	...	...	...	...	...	...		
	Sholapur	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	.	...	..	
	Belgaum	...	...	...	...	...	...	...	1	...	..	...	1	...	...	...	...	..	...	...	
	Karwar	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	..	...	
Madras.	Gopalpore	...	...	...	...	...	...	..	...	...	1	...	...	...	...	...	...	...	...	...	
	Bangalore	...	...	...	...	...	1	1	...	...	...	...	...	...	.	...	...	...	...	...	
	Bellary	1	...	...	...	1	1	...	...	1	...	...	..	...	..	...	1	...	.	..	
	Cochin	...	...	...	...	...	...	1	1	..	...	...	...	...	...	.	1	...	...	...	
	Coimbatore	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	..	
	Madura	...	...	...	...	...	1	...	...	...	...	...	...	...	..	...	1	...	...	...	
	Mangalore	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	..	
	Negapatam	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	
	Salem	...	...	...	...	...	...	1	...	...	..	...	...	...	...	...	...	...	...	...	
	Secunderabad	1	...	1	...	...	...	...	1	1	...	...	..	...	...	...	1	...	...	..	
	Trichinopoly	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	1	...	...	...	
	Wellington	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	
British Burma.	Akyab	...	...	...	...	1	...	1	..	...	...	...	...	...	...	...	...	...	1		
	Thyetmyo	1	...	...	...	...	...	...	..	...	.	...	...	...	...	...	...	...	...	..	
	Tounghoo	1	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Bassein	1	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	..	
	Rangoon	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	1	..	
	Moulmein	...	1	1	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	..	
	Mergui	...	...	...	...	...	...	..	1	...	...	...	...	...	...	...	...	.	...	...	
Extra Indian.	Amini Divi	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	1	..	.	.	
	Aden	...	.	...	...	...	...	1	...	...	...	...	...	...	...	...	.	...	...	..	
	Leh	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	1		...	..	
	Quetta	1		1	1	1	1	1	1	1	1	...	...	...	...	...	...	...	...	..	
	Seychelles	1	1	1	1	1	1	1	...	...	1	1	1	1	...	...	..	.	...	..	1 Original furniture
	Minor stations not under the Meteorological Department.	1	...	...	1	...	...	...	...	...	...	...	2	5	...	...	...	...	...	...	

METEOROLOGICAL OFFICERS AND OFFICE WORK.

The general control of the meteorological observatories and offices in the different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the past year:—

Province.	Superintending Officer.	Names.
Bengal and Assam	Meteorological Reporter, Government of Bengal	John Eliot, M.A. Alexander Pedler.
North-Western Provinces and Oudh	Meteorological Reporter, North-Western Provinces and Oudh	S. A. Hill, B.S.C. W. N. Boutflower.
Punjab	Meteorological Reporter, Punjab	Surgeon E. Lawrie, M.D.
Central Provinces	Sanitary Commissioner	Deputy Surgeon General, B. Simpson, M.D.
	Meteorological Reporter, Government of India	H. F. Blanford, F.R.S. John Eliot, M.A.
Berar	Sanitary Commissioner	Dr. Little.
	Meteorological Reporter, Western India	F. Chambers. Surgeon W. Nolan, M.D.
Central India and Rajputana	Meteorological Reporter, North-Western Provinces and Oudh	S. A. Hill, B.S.C. W. N. Boutflower.
	Meteorological Reporter for Western India	F. Chambers. Surgeon W. Nolan, M.D.
Bombay	Ditto ditto ditto	F. Chambers. Surgeon W. Nolan, M.D.
Madras	Meteorological Superintendent, Madras	N. R. Pogson, F.R.S. Miss Isis Pogson.
Burma	Meteorological Reporter, Government of Bengal	John Eliot, M.A. Alexander Pedler.
	Sanitary Commissioner	W. Pearl, M.D.
	Meteorological Reporter, Government of India	H. F. Blanford. John Eliot, M.A.
Bay Islands	Senior Medical Officer, Port Blair	Surgeon W. Beatson. „ J. Reid, M.B.
	Meteorological Reporter Government of India	H. F. Blanford. John Eliot, M.A.
Extra Indian Observatories	Meteorological Reporter, Punjab	Surgeon E. Lawrie, M.D.
	Meteorological Reporter, Government of India	H. F. Blanford. John Eliot, M.A.
	Meteorological Reporter, Western India	F. Chambers. Surgeon W. Nolan, M.D.

From the 6th December 1881 to the 5th March 1882, Mr. J. Eliot officiated as Meteorological Reporter to the Government of India, during my absence on privilege

leave, and Mr. A. Pedler officiated during the same period as Meteorological Reporter to the Government of Bengal.

Mr. Hill was absent on leave from the 27th April to the 25th June 1881, during which interval Mr. Boutflower officiated as Meteorological Reporter to the Government of the North-Western Provinces and Oudh.

And in Bombay, Mr. F. Chambers was absent, on privilege leave, from the 3rd October to the 27th December 1881, during which time the duties of his office were carried on by Surgeon-Major W. Nolan, M.D., who was appointed to officiate as Meteorological Reporter for Western India, his services having been placed at the disposal of the Government of India.

In Madras, Miss E. Isis Pogson was appointed Meteorological Superintendent to the Government of Madras, in lieu of the Meteorological Reporter, Mr. N. R. Pogson, who had expressed a desire to be relieved of the appointment. Miss Pogson entered on the duties of the office in July 1881. This appointment is the only permanent change that has been made in the *personnel* of the staff. I am glad to report that I have no longer to complain of the preparation of the Annual Report being seriously retarded by any delay in the transmission of the registers of the Madras stations, and the registers are carefully checked and reduced in the Superintendent's office.

At the same time, greater despatch in the communication of the registers is very desirable, in the case, not only of Madras, but also of the North-Western Provinces, the Punjab, and some Burma stations. In the case of the three first-named provinces, the delays are undoubtedly due to the fact that the local office establishments are insufficient to deal promptly with the registers, in the face of the increasing work thrown upon them, not only by the increase of the number of observatories with which the Madras and North-Western Province officers have to deal, but also by the increased demand for special returns of various kinds which are required by the Local Governments and their subordinate departments. In the case of the Burmese stations, more particularly Rangoon, the fault lies with the observers, and can be dealt with departmentally; but the Reporters for the North-Western Provinces, the Punjab and Madras certainly require some additional assistance.

The following table shews the number of stations the registers of which were sent to each of the Reporters respectively during the year under report:—

Provinces.	Meteorological Reporters.						Total.
	India.	Bengal.	North-Western Provinces and Oudh.	Punjab.	Western India.	Madras.	
Bengal and Assam	3	19	...	...	...	...	22
North-Western Provinces and Oudh	2	...	15	...	...	...	17
Punjab	...	...	...	11	...	...	11
Rajputana and Central India	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay	...	...	...	...	13	...	13
Madras, Mysore and Coorg	...	...	...	...	...	14	14
Burma	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	5	...	...	1	1	1	8
Total	32	20	19	12	22	15	120

This list does not include the registers of the Colaba observatory, of Goa, Jeypore, and Vizagapatam, which are furnished to the Meteorological office with all the necessary reductions.

The number of stations dealt with in the office for India is reduced by four, as compared with that given in last year's report. This is accounted for by the suppression of the two observatories of Thull and Ootacamund, and the transfer to Madras office of those at Mercara and Mangalore. The addition of these two observatories to the Madras Reporter's list, and the establishment of the Amini Divi observatory raises the number under that office from 12 to 15, and the number under the Reporter for the N.-W. Provinces and Oudh is raised from 16 to 19 by the addition of the three new observatories at Pauri, Pithoragarh, and Ghazipur. In Bengal and the N.-W. Provinces, the Meteorological Reporters superintend, also, the numerous rainfall registers of the district and sub-divisional stations of their respective provinces, and prepare weekly or monthly returns of the rainfall; and in Bengal and Bombay, the Reporters have also charge of a system of daily reports received by telegraph; in the case of the former from 15, in that of the latter from 10 stations. The Meteorological Reporter for Bengal also administers a system of meteorological registration at sea, which received a considerable development about the close of the year.

Office Establishments.—The following is a return of the number of employés in the offices of the several Meteorological Reporters, as far as information has been received up to the end of the year under report:—

	India.	Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	Total.
Head clerks	1	1	1	1	1	1	6
Computors	2	...	4	1	6	1	35
Clerks and Copyists	3	2					
Tabulators	13	3					
Draughtsmen	2	...	...	...	...	...	2
Artisans	...	3	...	...	...	...	3
Peons and menials	6	4	1	1	1	1	14

The offices for India and Bengal were during a part of the year, as in former years, under the management of the same Head Clerk, Babu Fanindra Mohun Basu, of whose excellent service I have much satisfaction in recording my entire approval. His health unfortunately failed him both in the cold weather of 1880-81, and again during the rainy season, compelling him to be temporarily absent from office; and in the absence of any junior clerk competent to discharge his duties, an undue amount of vexatious detail was thrown upon Mr. Eliot, who was then in charge of the Calcutta portion of my establishment in addition to his own. As, moreover, the work of both offices had increased so much since 1875 that, even when the Head Clerk was in good health, the duties had become almost too onerous for one controlling clerk, the two offices were separated in August last, and another Head Clerk was appointed to the management of the Bengal Office, who should, moreover, take temporary charge of that of India, in the event of Babu

Fanindra Mohun Basu being again incapacitated by sickness. On the 24th August, Babu Fanindra Mohun Basu made over charge of the office of the Meteorological Reporter for Bengal, an office which he had held for nearly twelve years, and on this occasion Mr. Eliot remarks: "I cannot allow the opportunity . . . to pass without expressing my sense of the zeal and ability with which he has discharged his duties in that capacity for so many years. It is very largely owing to his power of work and control over the clerks in the office that it has adapted itself readily to the expansive changes which have been made in it since its establishment, and that it has always been equal to the various duties imposed on it by Government, and that there has never been any accumulation of arrears in the work of the office." I am glad to be able to add that during the past cold season his health has been so much better than for two or three years previously, that he has been able to attend office without interruption.

The position of that portion of my establishment which has to deal with the reduction of the registers and the tabulation of the data, for publication in periodical reports and other forms, or for communication to other departments requiring information, has been much improved during the past year, by the formation of a superior grade on higher salaries. From the 24th September and up to the close of the year the tabulators were classified in three grades on salaries as follows:—

3	of the	first	class	at Rs.	40	rising to Rs.	55
6	„	second	„	„	„	30	„	„	„ 40
3	„	third	„	„	„	20	„	„	„ 30

Some additions to the office for dealing with marine observations have been sanctioned, but these did not take effect until the beginning of the current year.

An additional clerk has been sanctioned for the office of the Madras Superintendent, but Miss Pogson's office, as well as those of the Meteorological Reporters for the North-Western Provinces and the Punjab require some additional assistance, and application for this will be submitted as soon as I receive the necessary details. The Meteorological Reporter for Western India also remarks on the insufficiency of his office establishment; but I reserve my opinion on this subject until I shall have visited Bombay and enquired into the subject on the spot.

Weather Bulletins and Storm Signal Service.

The publication of the daily weather bulletins, by the office of the Meteorological Reporter to the Government of India, has been carried on during the past year, in the manner described in the report for 1880-81. They were issued at Simla from the 16th May to the 15th October, the Simla issue being amplified by telegraphic reports from 34 additional stations, of which 24 reported rainfall only; and a verbal notice descriptive of the principal features of the weather of the day accompanied the tabulated contents of the telegrams. A telegraphic abstract of this notice was sent daily to the Meteorological Reporter for Bengal, and was offered also to the Meteorological Reporter for Western India, but was declined by that officer.

Since the beginning of the present official year, the system of the daily weather reports have been greatly amplified; and, during the present season, the telegraphic summary is forwarded to all the Local Governments and Administrations.

A new edition of the Indian Weather Telegraphic Code has been prepared by Mr. J. Eliot, in order to take advantage of the increase in the number of words allowed

to the single message, under the Telegraph Rules which came into operation last January. Mr. Eliot has, at the same time, improved the Code, by making provision for the case in which any class of observations cannot be recorded, and has introduced additional items of information, *viz.*, the maximum and minimum temperature, the actual velocity of the wind at the hour of observation, and a more copious weather vocabulary for the same hour. The first and fourth of these additions were suggested by Dr. Murray Thomson and Mr. Chambers as desiderata. Some other improvements were also made on the suggestion of Mr. Pogson, to meet a difficulty that had been felt at Madras. The new edition of the Code was sent to press in the beginning of April. It has now been circulated, and came into operation on the 1st August 1882.

The Bengal system of weather report was greatly improved at the beginning of the official year 1880-81, when the number of reporting stations was increased to 15, and the tabulated data, accompanied by a descriptive notice, and illustrated with a chart of the Bay, was lithographed daily in the office and distributed to Government offices and private subscribers. At the beginning of the year under report, there were 18 of the former and 27 of the latter. At its close, the former had been increased to 23, the latter remaining the same; so that the daily circulation amounts to 50 copies. This work is very exacting, as, during seven months, Mr. Eliot is alone at the Meteorological office, and the work being personal and such as cannot be committed to the establishment, in the event of Mr. Eliot's absence, even for a day (Sundays and holidays included), he must find some other officer to take it over. This he has hitherto been able to do by the kind assistance of Mr. Pedler, and there has been no interruption of the issue. The information given in these daily issues is much appreciated in Calcutta, as is evidenced by the steadiness of the subscription list and the increased demand by Government officials.

The storm signals have, happily, not been much in use during the past year. No violent storm occurred in the Bay, and although, during the rainy season, a succession of small cyclonic vortices were formed in the head of the Bay, and were successively propagated across the Orissa coast towards the Central Provinces, Mr. Eliot reports that only one of these seemed to be of sufficient magnitude and importance to justify the hoisting of the bad weather signal. This was at noon on the 15th July, and the signals remained exhibited for 48 hours. At the close of the monsoon, a small cyclone was formed off the east coast of Ceylon, which reached the coast of Madras and did much damage to the breakwater of the harbour.

Mr. Eliot has devised a new and more elaborate system of storm signals, which, at the close of the year, was under the consideration of the Bengal Government, and has since been approved and sanctioned. The increased knowledge of storms which has been gained by the experience of the storm-warning service during the last 17 years, has enabled Mr. Eliot to distinguish the prognosties of major and minor storms; and although these storms approach from the open sea, from which, at present, no telegraphic reports are forthcoming, he is of opinion that it may be practicable, in many cases, to indicate approximately their probable course, whether they are making for land to east or west of the Hooghly. Information on this point will be of the highest importance to the shipping in the river, as it will enable shipmasters to foresee the quarter from which violent winds may be expected. This information the new code of storm signals is intended to impart, and provision has also been

made for doubtful cases, so that when the course is doubtful there may be no risk of misleading by false information.

I have stated above that, at present, no information is obtainable for estimating the probable course of cyclones from any point beyond the boundaries of the land. But a proposal is now before Government, which, if sanctioned and carried into execution, will add very greatly to the precision and certainty of the information obtainable on this head. It is proposed to put the light-ship at the Eastern Channel in telegraphic communication with the land by means of a cable. This will provide a warning station, 60 miles at sea, (from the shore of the Sunderbans), and not only will storm phenomenon be intercepted and reported many hours earlier, but the station will have all the advantages of an open sea observatory, free from the masking and mitigating influences of the land. I anticipate the most important results to the efficiency of the storm-signal service, if this proposal is carried into effect.

Of the working of the storm-signal service in Bombay, Mr. Chambers has given a very full account in his report (Appendix E).

ANNUAL REPORTS.—The report on the Meteorology of the year 1880 was completed (with the exception of one or two pages of summary), and in the printer's hands, by the end of November 1881. And the report was submitted to Government in its complete form on the 25th June 1882.

It gives tables of temperature for 126 stations, and rainfall returns for 399 stations, being an increase of 3 of the former and 34 of the latter on the number summarized in the corresponding tables of the Report for 1879. The returns of pressure, wind direction, and the other meteorological elements are nearly as numerous as those of temperature; and the tables include, for the first time, registers of the ground temperature. The elements tabulated in the appendices are as follow. I give for comparison the number of registers summarized in the corresponding tables of the reports of the four previous years:

	Number of stations.				
	1876.	1877.	1878.	1879.	1880.
Equilibrium temperatures of solar radiation	80	95	99	106	109
Temperature of nocturnal radiation	65	95	97	106	108
Temperature of the ground	...	...	...	...	2
Mean and extreme air temperatures	95	108	116	123	126
Sea-level equivalents of mean do.	77	94	100	101	105
Means and extremes of atmospheric pressure	92	106	113	119	122
Sea-level equivalents of mean atmospheric pressure	76	93	96	98	105
Direction and movement of winds	91	109	113	118	124
Temperature of evaporation	86	99	106	111	115
Tension of atmospheric vapour	95	106	113	120	123
Mean relative humidity	95	106	114	120	123
Mean proportion of clouded sky	91	104	110	118	122
Inches of rainfall in each month	274	311	353	365	399
Number of days on which rainfall was measured	217	239	276	365	379

The descriptive letterpress discusses the meteorology of the year in detail. It includes 21 numbered tables, giving the average values of all the more important elements, for all stations that have furnished registers for three years and upwards; and the report is illustrated with ten plates, one of which is a chart shewing the positions of all observatories and rain-gauge stations; three represent the distribution of pressure, temperature, and winds in each month of the year; and the remainder illustrate particular phases of weather, *viz.*, the conditions of the cold weather rainfall, and the cyclones that characterize the rainy season. One of these latter illustrates the daily progress of the storm, that culminated in the disaster of the Naini Tal landslip.

The original observations at six stations in India, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras, were issued in monthly parts as a distinct publication, and form a small quarto volume, prefaced by a detailed description of the stations and the instruments employed. The final sheets of the registers for 1880 were issued in December 1881.

Mr. Hill has also published, independently, a summary of the observations of the observatories which he superintends; and Mr. Chambers also prepared and printed a sketch of the local meteorology of Western India, in pamphlet form.

Miscellaneous publications.—Two parts of the Indian Meteorological Memoirs (Parts V and VI) were issued during the year, completing volume I of this publication, which has also been issued as a complete bound volume.

The final parts, contained two papers by Mr. S. A. Hill and one short paper by myself, together with a full and detailed index of the contents of the volume, a page of corrigenda, &c. The volume contains twelve original memoirs, occupying 426 quarto pages, and illustrated by thirty-three plates. Of other casual writings, Mr. Hill has contributed two papers to the Royal Society, discussing the question of the particular constituent of the atmosphere which has the greatest absorbing power for radient heat; and Mr. Chambers has drawn up a list of the storms recorded on the coasts of the Bombay Presidency, which will be published in volume II of the Indian Moteorological Memoirs. This was not received until more than two months after the close of the last official year.

Mr. J. Eliot has completed one memoir, also for publication in the first part of volume II of the Indian Meteorological Memoirs, and has the materials for two other investigations in hand. This first is a very full and detailed report on the south-west monsoon storm, which occurred at the head of the bay and passed across Central Bengal in September, 1878. The materials of the discussion were collected by Mr. Pedler, and as it appeared to be a typical example of this class of storms, Mr. Eliot has investigated very fully the meteorological conditions under which it originated and was developed. The other subjects on which Mr. Eliot has been engaged are: first, an enquiry into the probable relations between the abnormal variations of pressure over India during the pre-monsoon period, March to May inclusive, and the abormal distribution of rainfall during the succeeding months of the south-west monsoon; and, second, an investigation of the existence and character of the regular oscillatory changes of atmospheric pressure in India, other than annual and diurnal oscillations. Some further remarks on both these objects of enquiry will be found in Mr. Eliot's report (Appendix A).

The discussion of the old registers of Indian rainfall and the preparation of a general rainfall chart of India have occupied the little spare time that I have been able to devote to special work of this kind. The former, when completed, will be published, together with the data in full, in the Meteorological Memoirs. For the latter, a special contoured map of India is now being prepared in the office of the Surveyor General, on which the rainfall data will be laid down. As contributions to this work, Mr. S. A. Hill has already prepared and published a rainfall chart of the North-Western Provinces and Oudh; and I have reduced and laid down the data for the Madras Presidency and Mysore, while Mr. Hill has done the same for that of Bombay. It is proposed to submit these portions for the opinions of the local officers, before putting them together on the general chart, and it is hoped that the final work will be of such a character that it may be referred to, with confidence, by those engaged in agriculture, irrigation schemes and other undertakings, in which a knowledge of the local rainfall is an important datum.

A comparative return of the rainfall of India in 1881 was prepared, and, together with illustrative charts, submitted to Government for communication to the Secretary of State on the 11th April 1882.

Appendix I gives a list of the Government officials, offices, libraries, institutions, &c. to which the publications of the office are presented, including those which furnish their own publications in exchange.

LIBRARY.

The Library is contained in five large double book-cases and is in excellent condition. The list of the additions made during the past year is given in Appendix J.

HENRY F. BLANFORD,

Meteorological Reporter to the Government of India.

SIMLA:

The 26th August 1882.

APPENDIX A.

Extract from the Administration Report of the Meteorological Reporter to the Government of Bengal, for the year ending 1881-82.

DURING the year 1881-82 meteorological observations were taken regularly at one first-class observatory, seven second-class observatories, and twelve third-class observatories in Bengal and Assam.

From the 1st of April 1881 to the 6th of December 1881, the Department was under my superintendence. From that date up to the 5th of March 1882, during which I was acting as Meteorological Reporter to the Government of India, on account of the absence of Mr. H. F. Blanford on three months' privilege leave, Mr. Alexander Pedler, Professor of Chemistry, Presidency College, officiated as Meteorological Reporter to the Government of Bengal. For the remainder of the official year, the Department was under my superintendence. These changes, to a certain exent, interfered with the inspection of the Bengal observatories. As Meteorological Reporter to the Government of India, I was absent during the whole of the cold weather college vacation, inspecting the observatories in the Punjab, and certain observatories in the Madras Presidency. Mr. Pedler was unable to leave Calcutta during this period, as the preparation of the India and Bengal Telegraphic Weather Reports necessitates the presence of either the India or Bengal Reporter in Calcutta. Mr. Pedler, however, took the opportunity of several college holidays in February, to inspect those observatories which appeared more imperatively to require it.

Second-class Observatories.—These are seven in number, as in the previous year. Five are in Bengal, and the remaining two in Assam. The names of the Superintendents and Observers at these observatories are given in the following table:—

Second-class Stations.

Stations.	Superintendents.	Superintendents' allowance.	Observers.	Observers' allowance.	Assistant Observers.	Assistant Observers' allowance.
		Rs.		Rs.		Rs.
Sibsagar	Dr. R. M. Meiklejohn	30	Babu Dundadhar Dutt Barua.*	30	Babu Brikodar Dutt [1].	10
Dhubri	„ J. McNaught [3]	30	Munshi Maniruddin Ahmed* [6]	30	Babu Ratneswar Gogoi [2].	10
	„ J. Slane [4]				Munshi Kadimuddin.	
	„ J. Mullane [5]		Munshi Kadimuddin [7].		Mahamud Sukhua [8]	
Bankipore	„ R. Bird [9]	30	Munshi Mohabut Lal.	30	Modden Mohan Lall.	10
	Babu Kamkali Goopto [10]					
	Dr. J. C. Shaw [11]					
	„ B. Simpson [12]					
	Babu Ramkali Goopto [13]					
	Dr. B. Simpson [14]					

[1] To 23rd September 1881.
[2] Since 11th October 1881.
[3] From 1st to 9th April 1881.
[4] „ 10th to 12th April 1881.
[5] Since 13th April 1881.
[6] Privilege leave from 25th September to 23rd December 1881.
[7] From 25th September to 23rd December 1881.
[8] From 25th September to 23rd December 1881.
[9] 1st to 30th April 1881.
[10] 1st to 19th May 1881.
[11] 20th May to 17th December 1881.
[12] 18th December 1881 to 28th January 1882.
[13] 29th January to 22nd March 1882.
[14] Since 23rd March 1882.

* These officers are to receive the special allowance of Rs. 5 per month each from the 1st April 1882.

Second-class Stations—continued.

Stations.	Superintendents.	Superintendents' allowance.	Observers.	Observers' allowance.	Assistant Observers.	Assistant Observers' allowance.
		Rs.		Rs.		Rs.
Hazaribagh	r. R. Cobb [15] „ J. Lewtas [16] „ R. Cobb [17]	30	Raheemolla [18] Mahomed Ameer [19]	30	Mahomed Ameer [20] Nathoo Lal ([21])	10
Saugor Island	.....	...	Mr. R. H. Peters [22] „ R. A. Pope [23]. „ R. H. Peters [24]. „ E. R. Swatman [25]. „ R. H. Peters [26]. „ J. M. Brachio [27]. „ E. R. Swatman [28].	45		
Cuttack	.....	...	J. C. Smith	32	Mr. H. W. Alley [29] „ G. S. Adshead [30]. „ S. Adams [31]	13
Chittagong	.....	...	E. Pereira	32	„ J. Dias	13

[15] 1st April to 5th November 1881.
[16] 6th November 1881 to 8th February 1882.
[17] 9th February to 31st March 1882.
[18] 1st April to 12th June 1881.
[19] Since 13th June 1881.
[20] 1st April to 12th June 1881.
[21] Since 13th June 1881.
[22] 1st to 12th April 1881.
[23] 13th April to 26th May 1881.
[24] 27th May to 17th December 1881.
[25] 18th December 1881 to 4th January 1882.
[26] 5th January to 9th March 1882.
[27] 10th March to 20th March 1882.
[28] From 21st March to 31st March 1882.
[29] 1st April to 10th July 1881, 1st to 11th September and 12th October 1881 to 31st March 1882.
[30] 13th to 25th August 1881.
[31] 11th July to 12th August 1881, 26th to 31st August 1881, and 12th September to 11th October 1881.

Five of these observatories are provided with self-registering anemographs. The following table gives the periods during which the instruments have been in working order at each station :—

Stations.	Date of commencement of work.	Periods during which instrument was out of order in 1881-82.
Dhubri	18th March 1882.	
Hazaribagh	15th April 1880.	
Chittagong	20th June 1879	Since 6th February 1882, for repairs to the Telegraph building.
Saugor Island	9th February 1880	9th January to 22nd February 1882.
Cuttack	11th April 1879.	

The only observatories of this class which were inspected either by Mr. Pedler or myself are Dhubri and Patna. The transfer of the Goalpara Observatory to Dhubri, referred to in my last report, was effected during the year. The change was made on the 10th April 1881, from which date the ordinary observations have been regularly taken. I visited the observatory in November, to ascertain whether the anemograph house, the cost of erection of which had been sanctioned by the Assam Government, was progressing. I found that little had been done, and that the probability of its being completed during the official year was very doubtful. Afterwards, however, acting under instructions received from the Chief Commissioner of Assam, the Executive Engineer pressed forward the work, and the building was completed on the 17th of March 1882, and handed over to the

Meteorological Department. Several fairly satisfactory traces have already been received from Dhubri. The Dhubri Observatory was generally in very good order, and as its position is an open one, and the Observer is careful in his work, it will furnish, I have little doubt, a series of valuable observations.

Mr. Pedler inspected the Bankipore Observatory in February. This observatory is, I regret to state, in a less satisfactory condition than it ought to be. It was stated in the last report that, with a view to retaining the services of the Observer, who has been many years in the Department, arrangements had been made for the removal of the observatory to a suitable site in the Temple School of Medicine, on condition that the Observer and Assistant Observer should take simultaneous readings of the thermometers at the old and new sites, for twelve months, to enable me to determine the temperature differences between the old and new sites. By this plan, it would have been possible to make comparison between the future temperature returns of Bankipore and the past returns. A letter was received from the Superintendent, in August, stating that the Telegraph Department were erecting a building quite close to the old observatory, and that this circumstance affected the readings of the thermometers so much, as to render the simultaneous readings useless for the purpose of comparison. As it was impossible for me to visit the observatory at that time, I could only act on the opinion of the Superintendent, and gave orders that readings at the old observatory might be discontinued if his statements represented the exact facts of the case. This was accordingly done. The additional observations ceased on the 31st of August. When Mr. Pedler went to visit the observatory I asked him to ascertain whether the circumstances were such as to justify the discontinuance of the simultaneous observations. His remarks on the point are :—

"The position of the old observatory, with reference to the new Telegraph buildings, was inspected, and the minimum distance was found to be about 60 feet. There would, therefore, not appear to have been the necessity for discontinuing the comparative observations between the old and new observatories on 1st September 1881, which was indicated in letter No. 401, dated 1st August 1881, from the Civil Surgeon."

I regret this much, as it confirms an impression I received on my last visit to the Bankipore Observatory that the Observer is careless about his meteorological work, now that he has been allowed to combine with it the more remunerative duties of Head Clerk in the Temple School of Medicine.

The following is Mr. Pedler's inspection report of the observatory :—

"Inspected the Patna Observatory at the Temple School of Medicine, on 26th February 1882. The instruments, on the whole, were not in such good working order as they ought to have been. Most of the thermometers were in good order, but the wet bulb hygrometer showed slight signs of an encrustation on its surface. The Observer, however, said that only rain water had been used for moistening the muslin. The thermometer shed, though not accurately of standard pattern, appeared a fairly good one ; except that the thatch is thin on the south end at the ridge, and that the eaves are rather too high above the ground. The barometer is in an excellent position, and is in excellent working order ; but the Observer, in recording it, was not careful to read to the highest point of the meniscus. He seemed to have a personal error of about ·008 inch.

"The anemometer was in good order, but the wind-vane had evidently not been oiled for a long period, and it worked with much friction. There is little doubt that the recent observations of wind-direction are not to be implicitly depended on. The direction of the pointers is correct. The rain-gauge is rather too near the fencing round it, and the bottle and funnel were dirty.

"The grass radiation pad had been used by the Observer since 1st September 1881, without removing the covering of waxed-cloth in which it had been sent to him by post. It is difficult to say whether this was due to carelessness or ignorance."

From the above report, it is evident that the state of the observatory is anything but creditable to the Observer. The unoiled state of the wind-vane, the dirty condition of the rain-gauge, and the encrustation on the wet bulb thermometer, are evidences of continued carelessness and neglect on the part of the Observer, which it is only fair to assume would also shew itself in his work of observation, as well as in the condition of his observatory. The condition of the observatory as reported

last year (*vide* Administration Report) was not altogether satisfactory. I found that the anemometer was improperly and imperfectly fixed, and that, consequently, the returns of the wind-velocity were valueless for the whole of the preceding year, at least. The condition of the observatory has, judging from Mr. Pedler's remarks, evidently deteriorated during the past year. This has also been shewn by the frequent delays in the submission of the meteorological returns, and by the numerous mistakes which have been found in them by my office. If a change for the better does not take place, it may be necessary for me to advise the reduction of the Patna Observatory from the second to the third class. This would effect a saving of at least Rs. 55 per mensem, which might be spent in establishing two more third-class observatories, one in Northern Bengal and the other in Eastern Bengal, both of which districts are imperfectly represented in our meteorological system, as compared with West and South-West Bengal.

The Saugor Island and Cuttack Observatories are the best of my second-class observatories, and have worked very satisfactorily during the whole year. Dhubri and Chittagong came next in order of merit. Sibsagar is nearly equal to the last two in character of work, so far as I can judge by the returns. I regret I have been as yet unable to visit that station. The remaining two, Hazaribagh and Patna, are not, at present, as satisfactory as they ought to be. Both send in returns with numerous mistakes, and the returns are usually not received, until considerably after the proper time; so much so as to occasionally delay the publication of the monthly abstract. I regret to say that I have found it necessary to fine both Observers for delay during the past year.

Third-class Observatories.—These are twelve in number. Ten are situated in Bengal, one (Akyab) in Burma, and the remaining one (Silchar) in Assam. The conditions of these observatories are identical with what they were as stated in last year's report.

The following table gives the list of the third-class observatories, together with the names of the Superintendents and Observers during the year 1881-82:—

Third class Observatories.

Stations.	Superintendents.	Observers.	Observers' allowance.
			Rs.
Darjeeling, St. Paul's School.	R. Carter, Esq., Rector, St. Paul's School.	Mr. W. T. Moore [1]	25
Purneah	Dr. Picachy	Babu Russicklal Basu [2]	15
		„ Brojo Nath Sanyal [3]	
		„ Russicklal Basu [4]	
Durbhanga	„ J. C. Shaw	„ Jogin Chandra Banerjee *	...
	Babu Gopal Chandra Chatterjee, M.B.		
	Dr. N. J. Halpin		
	„ J. C. Shaw		
	„ J. F. Mullen		
Gya	D. R. MacLeod	Nowrungee Lal	15
Berhampore	Dr. S. M. Shircore	Babu Mahendra Nath Roy †	15
Burdwan	Baboo Dinobundhu Dutt [5]	„ Mokhoda Prosad Chowdhury †	15
	Dr. J. O'Brien, M. D.		

[1] From 1st October, when the observatory was established and commenced work.
[2] 1st April to 31st May 1881.
[3] 1st June to 31st August 1881.
[4] Since 1st September 1881.
[5] 1st April to 28th May 1881.

* Is to receive an allowance of Rs. 5 per month from the 1st April 1882 for good services.
† These officers are to receive the special allowance of Rs. 10 each per month from 1st April 1882.

Third-class Observatories—continued.

Stations.	Superintendents.	Observers.	Observers' allowance.
			Rs.
Jessore	Dr. A. Barclay [6] „ Taruk Nath Gangooly [7] „ D. W. D. Comins [8]	Baboo Poresh Nath Rai Chowdhuri	15
Dacca	.....	Mr. E. D. Shave	25
Silchar	„ J. J. Monteath	Baboo Romesh Chandra Bhadra [9] „ Mahendra Chandra Dutt [10]	15 ...
Dimagiri	.....	„ Kunja Behary Nundy [11] „ Nobin Chandra Ghose [12]	... ...
False Point	.....	G. S. Adshhead [14], H. W. Ally [13], J. P. Allen [15].	30
Akyab	.....	Mr. J. M. Bennett	25

[6] 1st April to 8th August 1881.
[7] 9th August to 20th October 1881.
[8] 21st October to 31st March 1881.
[9] 1st April to 19th September 1881, and since 21st November to 31st March 1882; was on privilege leave from 20th September to 20th November 1881.
[10] 20th September to 20th November 1881.
[11] 1st April to 25th November 1881.
[12] 25th November to 31st March 1882.
[13] 1st April to 13th July 1881, from 30th August to 5th December 1881.
[14] 14th July to 29th August 1881.
[15] 6th December to 31st March 1882.

No change has been made in the character of the observations taken at these stations. They are, with perhaps the exception of Purneah and Cachar, in a fairly satisfactory state. They require frequent inspection, as there is always a tendency on the part of the native Observers at these observatories (who are not very highly paid) to allow their instruments to get into a dirty state, and to take their observations in a careless and perfunctory manner, and after methods of their own invention, instead of those laid down very fully and clearly in their code of instructions, the *Vade Mecum*.

Four only of these observatories were inspected during the year, *viz.*, Burdwan, Jessore, and Berhampore, by Mr. Pedler, and Darjeeling by myself. Mr. Pedler's inspection report of the Burdwan Observatory is as follows:—

"Inspected the Burdwan Meteorological Observatory, and found all the instruments in excellent order and well placed as to exposure, &c. The wind-vane erected by the Public Works Department on a new tower, appears to be about 7° west of the true north. The records of the observatory are also well kept. The Observer himself appears to be very intelligent and well up to his work, and the observatory, as a whole, is in excellent condition."

The Burdwan Observatory has thus quite kept up its previous reputation, and the Observer has well earned, by the accuracy of his observations and the care he has taken of his instruments, the increment to his meteorological pay, which was granted to him, in accordance with the circular of the Meteorological Reporter to the Government of India of the 23rd November 1881, from the 1st of April 1882.

Berhampore was visited by Mr. Pedler on the 19th of February. The necessity of a reconstruction of the shed at that station was pointed out in my last Administration Report. Plans and estimates were submitted and sanctioned after the termination of the rains. The new shed was not quite completed at the time of Mr. Pedler's visit. It has since been finished, and the conditions of observation at Berhampore are now similar to what they are at other observatories. Mr. Pedler's report of his visit is as satisfactory as it is brief. He says:—

"Inspected the meteorological observatory at Berhampore. The Observer understands his work well. All the instruments were in good working order, though the new thermometer-shed was not finished. When completed, it will be a very good and substantial structure. The office records are also in excellent order."

The Berhampore Observer has been thirteen years in the Bengal Meteorological Department, and has always taken great interest in his work, and spared no pains to maintain his observatory in excellent condition. He has also received one of the increments of ten rupees per mensem for good work.

Mr. Pedler inspected the Jessore Observatory on the 12th February. The following are his remarks:—

"Inspected the meteorological observatory at Jessore on 12th February. The Observer was punctual in his attendance, but the observatory has not keen kept in good order by the Observer. The follow instances are sufficient to prove the want of attention of the Observer to his work and to the rules:—

"*First.*—There had been a slight separation of the column of mercury in the solar-radiation thermometer, which amounted to about 1·8°, and which had not been noticed by the Observer. This mercury was at the top of the tube, and therefore the readings are affected to that extent.

"*Second.*—The rim of the funnel of the rain-gauge had become separated from the collar, and this had not been reported. The funnel edge was not horizontal.

"*Third.*—The graduations of the wet-bulb thermometer or hygrometer were very indistinct.

"*Fourth.*—The cloth pad of the grass-radiation thermometer was in rags.

"As minor faults, I would mention that the ventilation hole of the thermometer shed wants repairing, that the cloth used to cover the bulbs of the two wet-bulb thermometers was too thick and coarse, and that the anemometer, although working fairly well, was scarcely sufficiently oiled."

The Jessore Observer was trained at Calcutta, and is thoroughly competent to do his work well if he chooses to take an interest in it. The state of the observatory, as described by Mr. Pedler, shews that he has been very careless—an inexcusable fault in an Observer. I hope when I visit this station next year to find a marked improvement in the condition of the observatory. If not, it will then be necessary to adopt more severe measures to ensure accuracy of observation at Jessore.

I visited the Darjeeling Observatory on the 20th and 21st of November. Sanction was obtained last year to the removal of the observatory from the Telegraph buildings to St. Paul's School, and for the erection of a suitable shed in the grounds of the school, and of a small building on the highest point of the grounds for the reception of the Casella's anemograph, originally intended for Patna. The observatory shed was finished in September, and the work of observation commenced on the 1st of October. There was some delay in the erection of the anemograph house in consequence of the Military Department contemplating the purchase of that portion of the grounds of St. Paul's School on which it was to be placed. As the Military Department finally decided to purchase the Lebong estate, the house was erected and finished on the 20th of March 1882. The sites of the observatory shed and of the anemograph house are very open, and the observations will be, I believe, of a high order for accuracy and value. Darjeeling is the only Indian hill station which has as yet been furnished with a self-registering anemograph, and its record will probably give valuable information of the daily changes of wind in the higher strata, consequent on the changes in the lower strata indicated by the diurnal oscillation of the barometer.

Burdwan and Berhampore are excellent observatories. Dacca and False Point, both under the care of Telegraph Masters, are, so far as I can judge from the returns of the past year, nearly, if not quite, equal to these two in the character of their work, and the carefulness and readiness with which the various returns are submitted.

The Akyab Observatory is not quite so satisfactory. Frequent mistakes are made by the Telegraph Master in the transmission of his weather telegrams.

Durbhanga, Gya, and Jessore follow next in order of merit. The work of the Silchar and Purneah Observatories during the past year, on the other hand, is not at all satisfactory. Mistakes frequently occur, and the Observers, I regret to say, appear to be specially slow in acting upon any hints, sent from the head office for the improvement of the observations. Hence the observations sent from these two stations are always open to a suspicion of want of accuracy, and are much less valuable than they ought to be. This is much to be regretted, as both stations are somewhat difficult

of access, and hence defects of observation at these stations tend to become permanent. On the other hand, they represent large and important areas, and defective or inaccurate observation for these areas, virtually excludes them from any advantages that are likely to follow from the accurate registration and continued study of meteorological observations. Cachar, moreover, is a very expensive station. The annual cost of petty repairs is more than twice that of any other station in my province. The explanations given, of the great cost of the repairs at that station, have never appeared satisfactory to me. If the means of rapid communication with Cachar are not established in the course of a year or two, it may be desirable to remove the observatory to a more accessible station. At present I consider the money spent in maintaining the Cachar Observatory as wasted.

Rain-recording stations.—These are 161 in number, as was noticed in the last report, and include the great majority of the revenue stations. During the course of the year, Chanchal in Maldah and Sonbursa in Bhagalpore were closed; but the establishment of two new stations, one at Baloorghat in Dinagepore, and the other at Kalimpong in Darjeeling, served to keep up the number of the rain-recording stations of last year. The rainfall returns are made up and forwarded weekly, and are generally sent in with punctuality, and thus enable me to publish the monthly return of rainfall in the Gazette, in the third or fourth week of the ensuing month.

Instruments.—The following tables give returns of the instruments broken or rendered unserviceable by other causes than ordinary use at the Bengal Observatories during the year 1881-82, and of the instruments supplied to replace broken instruments or instruments which have become inaccurate from prolonged employment:—

Return of Instruments broken or otherwise injured at the Observatories in Bengal and Assam, 1881-82.

	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer.	Wind-vane.	Rain-gauge.	Measure-glass.	Standard thermometer.	Lens.	Lantern.	Clock.	Anemograph.	Bottle for gauge.
Purneah	...	...	...	1	1	1*	1*	1†	...	...	...	...	1	...	...	...	...	...
Burdwan	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Patna (new station)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cuttack	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Chittagong	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
Berhampore	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
Sibsagar	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1§	...	...
Dhubri	...	...	...	...	...	...	1*	...	...	...	...	...	...	...	...	...	...	...
Cachar	...	...	...	...	...	...	1*	1†	...	...	...	...	...	...	...	...	...	...
Darjeeling	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
„ St. Paul's School	2*	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...
Jessore	...	...	...	...	...	...	1*	...	1‡	...	1‡	...	...	...	...	...	...	...
Akyab	...	...	...	...	1*	...	2	...	...	...	...	...	...	...	...	...	...	...
Saugor Island	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	
Gopalpore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hazaribagh	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...
False Point	...	...	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	...	...
Dacca	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Durbhunga	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Gya	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

* Returned out of order. † Returned broken. ‡ Returned for repairs. § Unserviceable and sold by auction.

The instruments which have hitherto required most frequent renewal are mininum (alcohol) thermometers and radiation thermometers. The latter instruments (*i. e.*, the solar radiation and terrestrial radiation thermometers) are exposed in the open for a portion of the day. They are liable to breakage by exposure, at unusual and unauthorized hours, by sudden hail-storms or gusts of wind, &c., and by the destructive tendencies of boys, cattle, &c. They also occasionally disappear at second-class observatories, when the Observer and his Assistant Observer are not on good terms. The number of these instruments replaced during the year is, on the whole, a fair index of the care which the Observer has taken of his instruments during the year. The above statement shews that Burdwan, Dacca, Gya and Durbhanga required no instrument to be supplied to them during the year. Purneah, Cachar, and Hazaribagh, all of which stations are not in so satisfactory a condition as I would wish, were each supplied during the year with two radiation thermometers. Berhampore, Chittagong, Sibsagar, and Akyab each required one radiation thermometer. The amount of breakage seems to me much greater than it might be, if the Observers, as a rule, were as careful as they ought to be in looking after the safety of these instruments. Stricter rules respecting the conditions of supplying instruments to replace broken or worn-out instruments appear to me to be imperatively necessary.

Central Office.—The office staff of the Bengal Meteorological Department consisted of the following on the 31st March 1882:—

Names.	Ranks.	Salary. Rs. A. P.
Babu Fanindra Mohan Basu	Head Clerk in charge	.....
„ Chundi Churn Chatterjee	Head Clerk from 24th August 1881	75 0 0
„ Poorno Chunder Mookerjee	Second Clerk	41 0 0
„ Debendra Nath Banerjee	Third do.	25 0 0
„ Kamini Mohun Basu	Tabulator	30 0 0
„ Jogesher Roy	Do.	20 0 0
„ Banikant Roy Chowdhury*	Do.	.....
„ Surendra Nath Banerjee	Offg. do.	20 0 0

* On deputation to Jubbulpore since 21st February 1882 for one year.

Babu Franindra Mohun Basu, Head Clerk of the India Meterological Office, was, until the 24th of August 1881, also Head Clerk of the Bengal Meteorological Office. The increase in the amount of work of the two offices, due to the various extensions recently made to the Department, rendered it necessary to place the two offices under separate Head Clerks. The proposal was sanctioned by the Government of India, and came into effect from the 24th of August.

The regular and systematic work of the office consists in the reduction of the observations of the Bengal and Assam stations, and their tabulation in the prescribed forms, for the preparation of the various returns of the Bengal and Indian Meteorological Reporters. The Bengal Office has prepared and published the following returns, during the year, in the *Calcutta Gazette*:—

(I.) A monthly summary; giving the averages or totals of the observations taken at the twenty observing stations in Bengal and Assam.

(II.) A monthly return of the rainfall, giving the rainfall of each day of the month and a comparison of the total rainfall of the month, with the averages of previous years at 161 revenue stations in Bengal.

(III.) A table shewing the monthly and annual rainfall in Bengal for 1881, at 167 revenue stations in Bengal.

(IV.) A table shewing the average monthly and annual rainfall at the revenue stations in Bengal.

(V.) Comparison table of the rainfall of 1881 at the revenue stations in Bengal, with the averages of the past years.

In addition to the regular routine work, the office has prepared the materials for two meteorological investigations, which I have undertaken during the past year. The first of these is an enquiry into the probable relations between the abnormal variations of pressure over India during the pre-monsoon period, March to May, inclusive, and the abnormal distribution of rainfall during the succeeding south-west monsoon months, July to September, inclusive. The comparison of the two shews that in every year out of the seven years for which it was made, except perhaps one, the connection between the two is what I indicated, from theoretical considerations, in my note on recent south-west monsoons, published in the year 1878; and that therefore, generally, a fair indication of the probable distribution of the south-west monsoon rainfall can be obtained by a study of the barometric variations during the pre-monsoon months.

One other interesting result, which I had also anticipated, seems to be established by the same investigation, *viz.*, that the abnormal variations upon which the local distribution of rainfall appear largely to depend, are usually generated and developed, or, if already existing, are intensified, during the period of greatest contrast of meteorological conditions over the Indian area, *viz.*, in the dry and hot weather months, whereas the effect of the approximately uniform conditions of great humidity and general uniformity of temperature of the rainy months, is to diminish the abnormal barometric variations, general and local, and to cause them to disappear when they are small in amount.

The second investigation was commenced, with the object of ascertaining the existence and character of the regular oscillatory changes of atmospheric pressure in India, other than the annual and diurnal oscillations. A cursory examination of the observations, published in the Indian Daily Reports, shews that the atmospheric pressure is in a state of constant oscillation, in the cold weather months as much as in the hot weather months, and in the dry season of the prevalence of the north-east monsoon, as well as during the humidity of the south-west monsoon. This more or less regular movement of the barometric column is due to pressure changes of the atmosphere, equally regular; produced either by alternate expansion and contraction, or other oscillatory movements. These changes, when combined with other conditions, may give rise to the general and local irregularities which constitute what may be called the weather at the time as distinguished from the regularities known as climate. On the other hand, they may take place and be of considerable amount, without any apparent irregular action in the atmosphere whatever. If this be true, it is essential, if the pressure changes are to be employed as one of the elements in the provision of weather, that these regular oscillatory movements of the atmosphere, intermediate between the diurnal and the annual period, should be estimated, and, if necessary, eliminated. This would be equally necessary in dealing with such a question as the relation between changes of the atmospheric pressure and the phenomena of storms.

These two investigations are practically completed, and ready for publication in the Indian Meteorological Memoirs.

As has been already stated, the work of the two Meteorological Offices (India and Bengal) has increased to such an extent as to render it necessary to engage a separate Head Clerk for the Bengal Office, and to limit the duties of Babu Fanindra Mohun Basu to the working of the India Meteorological Office. As Babu Fanindra Mohun Basu has performed the duties of Head Clerk of the Bengal Office for nearly twelve years, I cannot allow the opportunity of the severance of his connection with the Bengal Office to pass, without expressing my sense of the zeal and ability with which he has discharged his duties in that capacity for so many years. It is very largely owing to his power of work and control over the clerks in the office, that it has adapted itself readily to the expansive changes which have been made in it since its establishment, and that it has always been

equal to the various duties imposed upon it by Government, and that there has never been any accumulation of arrears in the work of the office.

Storm signals.—The weather in the Bay of Bengal, during the past year, was unusually quiet and free from storms. The south-west monsoon was established without the occurrence of any violent cyclone. During the south-west monsoon, a succession of small cyclonic vortices or south-west monsoon storms advanced across the coasts of Bengal and Orissa. Only one of these, however, seemed to me to be of sufficient magnitude and importance to justify the hoisting of the bad weather signal. This was at noon on the 15th July, and the signal remained hoisted up for about 48 hours, or until noon of the 17th July. The south-west monsoon terminated without any cyclone or severe gale at the head of the Bay; but as it retreated southwards in November, it gave rise to a remarkable cyclone in the south-west angle of the Bay. It was of very small intensity, as judged by the depression of the barometer at and near its centre. It was, however, accompanied by unusually strong winds and an excessively high sea, both out of proportion to the barometric depression; and, as a consequence, the Madras pier, which had withstood a previous cyclone of much greater intensity, (as judged by the barometric depression at its centre), was greatly damaged and partly overthrown.

I submitted an extended code of signals for giving more precise intimation respecting the character of approaching cyclones to the shipping in the port of Calcutta and River Hooghly, to the Government of Bengal, in the month of November last. It is, I believe, still under consideration.

Daily weather reports.—These have been published, during the past year, in the same form as was adopted originally in April 1880. They continue to give a Weather Chart of the Bay, together with the original observations, as taken at sixteen stations round the Bay, and a brief summary of the weather at that hour; and a forecast, when necessary, of the approach of storms towards the head of the Bay.

The reports were supplied to 27 paying subscribers and to 18 Government officials, at the commencement of the year; and, at the end of the year, to 27 subscribers and to 23 Government officials, making in all 50 copies distributed daily. There is a small balance in hand, after paying all expenses, which I am reserving to meet the cost of repairs of the occasional breakages of the lithographic presses. These are by no means unfrequent, as the work requires to be hurried through after my college work, in order that the report may be published and circulated before 4 or 5 P.M.

Maritime Meteorology.—During the past year, the Government of India called upon the Meteorological Reporter to the Government of India to submit proposals for the extension of the work of his department, in accordance with the suggestions of the Famine Commission. Amongst these proposals was one for the establishment of a small Branch Department of Maritime Meteorology, in connection with the India Meteorological Office, and which he proposed should be placed under my superintendence. These proposals were sanctioned, with effect from the 1st of April 1882. While the matter was under discussion, it was not considered advisable to extend the work of Maritime Meteorology commenced last year, but simply to continue it on the same footing. Hence, the work in this Department has been confined to the collection of observations taken on board the light-vessels, and to the examination of one portion of the observations in Indian seas, collected by the Board of Trade in England, and sent out here a short time ago. I have, however, received during the year meteorological extracts from the logs of several vessels entering the port through the kindness of S. R. Elson, Esq., Master Pilot, and of the captains of the vessels themselves, many of whom appear to be willing and ready to give any assistance in their power to the Meteorological Department.

In connection with this work, I have prepared a full report on a south-west monsoon storm which occurred at the head of the Bay, and passed into Central Bengal in September 1878. The materials for the discussion of this storm were collected by Mr. Pedler, and as it appears to me to be a typical case, I have devoted some time to a careful examination of the meteorological conditions and phenomena of the storm. The report is ready for publication in the Meteorological Memoirs, and will probably be printed and distributed during the present year.

FINANCE.

The following statement gives the total cost to the State of the Bengal Meteorological Department during the year 1881-82 :—

	Rs.	A.	P.	Rs.	A.	P.
Meteorological Reporter	3,600	0	0			
Office establishment	2,516	8	7			
Office rent	900	0	0			
Observers { Telegraph Masters[1]	2,655	0	0			
Observers { Native Observers	3,113	0	0			
Messengers' allowances	48	0	0			
Superintendents' allowances	1,440	0	0			
				14,272	8	7
CENTRAL OFFICE.						
Contingent and office furniture	538	0	3			
Postage	250	4	6			
Telegraphic messages	6,670	3	0			
Travelling allowances	512	4	0			
				7,970	11	0
OBSERVATORIES.						
Building and repairs	2,304	2	9			
Contingent	93	0	6			
				2,397	3	3
GRAND TOTAL				24,640	7	7

The total is considerably larger than it has been for previous years. The increased cost of the office establishment is due mainly to the addition of a Head Clerk, sanctioned by the Government of India from the 24th of August 1881. Office-rent has hitherto never been included in the statement through some oversight, but is now given for the first time. An additional charge, *viz.*, that for Telegraph Masters, who also perform the duties of Observers (and whose meteorological allowances are budgetted for and paid directly by the Telegraph Department, the total amount being debited to the Meteorological Department by a book transfer at the end of the official year,) also appears for the first time. The item "Telegraphic messages" is also somewhat larger than it was last year. This is due to the fact that, the weather telegrams despatched for the use of the Calcutta Storm-signal service were converted from "Service precedence bearing messages" to "Urgent messages," on or from the 1st January 1882, and now cost Rs. 2 instead of 1, as hitherto, for each telegram.

The item "Building and repairs" is considerably larger than it has hitherto been. The expenditure, under this head, for the past year has, however, been special in character, and is not likely to occur again for many years at least. It includes the cost of erecting two substantial buildings, to house self-registering anemographs, at Dubri and Darjeeling, and an observatory shed at Darjeeling. The cost of the Dubri building was Rs. 999, and of the Darjeeling building and shed was Rs. 698-8. The shed hitherto in use at Berhampore has, as already stated, been replaced by a new and substantial one.

The statement does not include the cost of instruments supplied to the observatories by the Indian Meteorological Department; nor does it include the cost of stationery supplied to the central office, or of printing the various forms required by the office, nor of printing the meteorological returns published in the Gazette or otherwise.

JOHN ELIOT, M. A.,
Meteorological Reporter, Government of Bengal.

METEOROLOGICAL OFFICE, BENGAL,
The 15th April 1882.

[1] Paid through the Telegraph Department.

APPENDIX B.

Administration Report of the Meteorological Reporter to Government, North-Western Provinces and Oudh, for the year 1881-82.

THE administration of the Meteorological Department in these provinces, during the year under report, continued on the same lines as in previous years. The only change in the number of observatories was the addition of one of the voluntary class at the Opium Factory, Ghazipur. Observations had been taken in a desultory way there for several years; but from the 1st January last, Dr. Weir, the Officiating Principal Assistant to the Opium Agent, commenced them on a regular system, and has since sent in monthly reduced registers, which agree closely with those of the neighbouring station, Benares.

Observatories.—The observatories now stand as follows: —

How maintained.	Class of observations they furnish.		
	First class.	Second class.	Third class.
By Meteorological Department	Allahabad (in abeyance)	Allahabad (temporary). Lucknow. Agra. Roorkee.	Chakráta. Ránikhet. Bareilly. Gorakhpur. Benares. Sutna. Jhánsi. Ajmere. Sambhar.
By other Government Departments	...	...	Dehra [1]. Gházipore [2].
Voluntarily or by Independent States, &c . . .	Jeypore (in part)	Jeypore [3]	Meerut [4]. Nowgong [5]. Pauri [5]. Pithoragarh [5].

[1] Maintained by Survey Department.
[2] Ditto Opium Agency.
[3] Ditto State Darbar.
[4] Maintained by Municipality.
[5] Observers unpaid.

The observatory at Sambhar, in Rajputana, which was established two years ago by the Inland Customs Department, has now been added to those which draw an Observer's allowance from the Meteorological Department allotment.

The twenty observatories named in the preceding list, may be classified into fifteen in the North-Western Provinces and Oudh, three in Rajputana, and two in the Central India States; also into five in the Himalayas, nine on the Gangetic plains, and six on the higher country south-west of the Jumna. There are also two observatories of the voluntary class at Mussooree, which report directly to the Meteorological Reporter to Government of India. The Himalayan Districts of the North-Western Provinces have thus seven observatories now, in all, but none of these are near the snows, the farthest back among the mountains being those recently established at Pauri and Pithoragarh. The system of observatories for the whole region would be very complete if there were a good observatory near the snows and another somewhere in the north of Oudh, between the Sarju and the Nepal frontier. The latter may perhaps be established, when the Patna-Bahraich Railway is opened; but there will always be a difficulty about the former, because most of the higher villages are deserted in winter.

In the classification of the observatories according to the nature of the observations they furnish, Class I. means that they register temperature, pressure, wind-direction and movement, &c., auto-

graphically; Class II., that eye observations are made three times daily, at 10 A.M. and 4 P.M., and at, 7 A.M., Washington time, the latter being intended for the United States International Weather Bulletin; also that hourly observations of the instruments are recorded on four days in each month. At stations of the third class, only the 10 A.M. and 4 P.M. observations, with rainfall and general weather observations at 6 P.M., are recorded. There is yet no fully equipped first-class observatory in Upper India.

Allahabad Observatory.—The building for the first-class observatory at Allahabad has not yet been commenced. Plans have been drawn and sites been chosen again and again, but still no progress has been made; the last cause of delay being a reference to Mr. Emerson, the English architect who designed the Muir College, where it was proposed to erect the observatory, and who objected to any addition that was not designed by himself, so as to be in harmony with the rest of the building. Meantime, as the present temporary site must be vacated before long, a thermometer shed has been run up near the College, and from the commencement of the current year, observations have been made there, for comparison with those recorded at the old observatory. It is possible that the first-class observatory may not be erected at Allahabad after all, but at Cawnpore, a station much nearer to the centre of the country; but, in any case, the Allahabad Observatory will be maintained on its present or a reduced scale, and the temperature comparison now instituted will therefore not be lost.

Jeypore Observatory.—The rapid progress made at Jeypore during the year, contrasts favourably with the interminable delays experienced at Allahabad. In the appendix, will be found a short note on the working of the observatory, drawn up by the Superintendent, Dr. Hendley, for the information of the Viceroy, at the time of His Excellency's visit in November last. It may be added that a handsome building, with a tower 50 feet high, is being erected for the accommodation of the meteorograph there being five rooms in the basement, intended for varnishing, engraving, printing, and various other operations subsidiary to the actual registration effected by the instrument. This building is now almost finished; and the instrument may be expected to yield valuable traces during the current year. In addition to the soil thermometers mentioned in Dr. Hendley's note, another one, giving the temperature 20 feet below the surface, has been read daily since the beginning of January. A record of these observations, as well as of the soil temperatures at Allahabad, will be found in the appendix.

Inspection of Observatories.—When on leave last May, I made an informal visit to Ranikhet, and found everything connected with the observatory there in fair order. Later on, I passed through Pauri, and set up the instruments at the new observatory there; and afterwards I visited Mussooree and determined the elevation of the barometer cistern at the St. Fidelis' Observatory. At the same time, Mr. Boutflower, who officiated for me, visited Roorkee and Chakrata. On my way back to Allahabad, in June, I inspected the observatories at Bareilly and Lucknow. In the first week of December I visited Sutna, where I found everything in good order, except a Casella anemograph, that had been recently set up; and afterwards I inspected Benares and visited Ghazipur, where I determined the errors of the barometers and thermometers that were in use. At the end of December, I started on a tour round the Rajputana stations, visiting Agra, Jeypore, Ajmere, and Sambhar.

Neither Mr. Boutflower nor I found much to complain of in the general condition of the observatories we visited, the instruments being, as a rule, clean and in good order. The least satisfactory station was Ajmere, where the thermometer shed had fallen in May, luckily without damaging the instruments, and had been rebuilt in such a fantastic and unstable-looking style, that it will probably come down again when a dust-storm strikes it. For want of a protecting railing, the radiation thermometers had been stolen shortly before my visit, though the ground where they were exposed is close to the beat of the sentry on guard over the treasury. For these accidents the Observer was not to blame, but he had neglected to keep a double register of rainfall, as directed at the time of my previous visit—one by the old gauge, 40 feet above the ground, and the other by a new instrument one foot above the ground. The Superintendent promised to get a railed enclosure erected at once, for the protection of the thermometers, so that now I hope the condition of

the observatory is improved in this respect. In every other way, the Ajmere Observatory has worked very well; the weather telegrams, for example, being always punctual and accurate.

Verification of Instruments.—Mr. Boutflower tested the barometers and thermometers at Roorkee and Chakrata, but found no errors of any consequence, except a rise of about 0·4° in the standard thermometer at Roorkee, which has been in use many years. At Ajmere I also found that a slight rise in the freezing point of the mercurial thermometers had taken place since they were first issued. When at Ghazipur, as above stated, I determined the errors of the instruments belonging to the Opium Department, and I also tested two or three thermometers at Jeypore.

The difference in the reduced readings of the barometers of Jhansi and Nowgong, mentioned in last year's report, was found not to be due to any instrumental error, but to an error in the supposed elevation of Nowgong above sea-level.

Special Instruments, &c.—The clock of the barograph at Allahabad was out of order for a short time, but the instrument is again working regularly. The earth thermometers have been observed four times every day, and the results are given in a table in the appendix. When the temperatures of the soil at Allahabad, from the commencement of the series, are freed from annual variation, they indicate a gradual and very regular, though slight, decrease, completely in accordance with the known law of the variation of temperature in tropical countries during the sun-spot cycle.

The means for the years whose middle points lie at the middle of each of the following months were :—

Epoch.	Temperature of			
	Air in shade.	Ground surface.	Ground 1 foot deep.	Ground 3 feet deep.
November 1880	77·52	83·30	81·59	82·20
December ,,	77·33	82·91	81·51	82·24
January 1881	77·17	82·54	81·37	82·19
February ,,	77·13	82·51	81·36	82·19
March ,,	77·07	82·47	81·36	82·21
April ,,	76·97	82·22	81·24	82·17
May ,,	76·80	81·77	80·98	82·02
June ,,	76·75	81·52	80·89	81·94
July ,,	76·85	81·46	80·96	82·02
August ,,	76·75	81·23	80·93	82·08
September ,,	76·80	81·05	80·87	82·07
Mean	77·01	82·09	81·19	82·12

On the mean of the whole series, the temperatures at the surface and at three feet depth are almost identical, and are five degrees above the temperature of the air. At one foot depth, however, the temperature is nine-tenths of a degree lower than at the surface. The cause of this difference may be, in part, a difference in the form of the diurnal variation at the surface and one foot deep, the mean of four observations, at 4, 10, 16 and 22 hours, giving very nearly the true daily mean at the surface, but being somewhat too low at a depth of one foot. To test this, hourly observations will be made on four days each month during the present year. The difference between the surface temperature and that at one foot depth decreases so considerably between November 1880 and September 1881 that it may be due to the cool wave of 1879, followed by the hot wave of 1880, that was superimposed on the general decrease of temperature which has recently occurred and is now taking place. The high temperature of the three feet thermometer, at the commencement of the series, may represent the heat of 1878, and that

at the surface the heat of 1880, while the lower temperature, at a depth of one foot, may be due to the cold of 1879. This would mean extremely slow conduction of heat from above downwards; and against this view may be set the slight increase of temperature after June 1881, which occurs simultaneously in the air and in the two lower soil-thermometers, but, strangely enough, is not apparent at the ground surface.

The Beckley anemograph at Roorkee worked thoroughly well, and we have now two volumes of traces from it waiting to be measured and tabulated. That at Lucknow never worked satisfactorily in the place where it was first put up, but since the 7th August it has been erected in a new position and now works admirably. The embossing instrument of Casella's construction, set up at Sutna on a building specially erected for it, has not given traces of any value. It would probably work very fairly in England or at a sea-coast station in India, but, for the interior of the country, it has the fatal defect of depending on the movement of the wind to carry forward the recording paper. Consequently, at night, when light winds and calms prevail, the hammer which embosses the direction mark, comes down hour after hour on the same spot, and twenty-four distinct impressions are hardly ever obtained in twenty-four hours. As there is no time-scale, it is impossible to identify the hours to which the several marks belong, and the instrument is thus almost useless.

Character of the Observations.—The mistake of following Madras instead of local time, mentioned in last year's report, has been avoided, and, in most other respects, the observations have been very well conducted. Nevertheless, there are differences in the work of the Observers, which are easily seen by one who has to revise their work. One man's returns are always punctual, neatly written, and in the weather remarks, &c., indicate an intelligent interest taken in the work, while another's do not evidence the same care and interest. Again, one Observer is frequently meeting with accidents to his thermometers of the most varied nature, while, at another station, the instruments are never damaged, accidentally or otherwise. In such matters as making obvious mistakes of ten or twenty degrees in reading a thermometer—mistakes to which the best Observers are liable—there are also very decided differences noticeable. And among the second-class Observers, who reduce their own observations and send in monthly registers, one will hardly ever make a mistake in computation, while another blunders frequently.

With a view to encouraging the best Observers to maintain their position, and to cause the others to emulate them, Mr. Blanford has obtained an allotment in the Budget for the present year, to be spent on personal allowances to those men who are most deserving. The Observers selected for these provinces are those whose names are marked with an asterisk in the list in the appendix. The first three are, this year, to draw an increased allowance of Rs. 10 per month, and the remainder an increase of Rs. 5. These allowances are to be forfeited if the observations deteriorate in character; and presumably, the names of other men who work up to certain standard of excellence may, from time to time, be added to the list, though I have no information regarding this point. If the prospect of a possibility of an equal increase be held out to the rest of the Observers, the system will be a most valuable incentive to good work.

Office and Office-work.—For two months last year I was absent on previlege leave, and the work of the office was efficiently conducted by Mr. W. N. Boutflower, Professor of Mathematics at the Muir College. The work has, however, been gradually falling behindhand, the number of clerks employed being too small to carry on the current work, and, at the same time, prepare the numerous tabular statements and returns, asked for by various authorities in and out of the provinces. Since the supply of meteorological information, when required, to officials and the public is the sole justification for the maintenance of the Department at the public expense, I have always tried to give such information when asked for it; but some people have little idea of the labour they thus throw upon a very small office establishment; and, on one occasion, I have had to decline to undertake the preparation of certain tables asked for, unless on condition that the authority who wanted the tables supplied the clerks to compile them. The simplest way out of such a difficult position would be for Government to increase the strength of the office establishment, and proposals for such an increase will be sent up this year.

The office establishment at the end of the year stood as follows :—

Name and designation.	Monthly pay.
	Rs.
Chintamoney Ghosh, Head Clerk	84
Kalliprosono Datta, Second Clerk	50
Makhan Lal Mookerjee, Third Clerk	30
Ram Charn Pande, Fourth Clerk	20
Sasi Bhusan Banerjee, Fifth Clerk	20
And a peon on Rs. 6 per month.	

It is chiefly in the work of reducing the observations and preparing the registers, copies of which are sent to the Meteorological Reporter for India, that the work has fallen behind. The monthly registers, abstracts of which are published in the local Government Gazette, are now got ready about six weeks after the proper time, and the last copies for the year 1881 were sent to Calcutta as late as the beginning of April. The weekly reports of rainfall, received from the district officers, are always published as soon as possible after they come in; and an annual table, giving the rainfall recorded at each station in 1881, the number of rainy days, and the average for each place, has also been published. This table shews clearly that the district returns are still subject to the errors pointed out last year. Even at the chief stations of districts, all showers of less than a tenth of an inch are neglected; and thus the total rainfall of the year is diminished, sometimes by as much as 20 per cent., while the number of rainy days is made to appear only one-half or two-thirds of the true number. The Provincial Government, having, at last, agreed to supply good gauges to all the chief stations of districts, it is hoped that the errors in the rain records will be less in future than in the past. During the year, gauges were set up at three of the pilgrim dispensaries in Garhwal,—Okhimath, Joshimath, and Karnprayag—all near the snows; and it is hoped that the returns they furnish will in a few years become useful, as a measure of the variations of the snowfall from year to year.

The observations, taken at Allahabad, have been published daily in the local newspapers; and, as in the previous year, a short chapter briefly treating of the meteorology of 1880 was drawn up for the Provincial Administration Report.

In the way of special scientific work, little has been accomplished, owing to the short-handedness of the office. The paper on the meteorology of the North-West Himalaya, mentioned in last year's report, has been reprinted, with certain additions, in the *Meteorological Memoirs;* the corrections to reduce the temperature observations to true daily means have been made out from the records of hourly observations at the second-class stations during the last seven years; all the old temperature registers of the observatories have been revised and corrected accordingly, and some progress has been made in the collection of materials for a general discussion of the temperature of North-Western India. Two short papers, discussing the question of the particular constituent of the atmosphere which has the greatest absorbing power for radiant heat, have been communicated to the Royal Society. In these it is shewn, from certain actinometric observations made at Mussooree and Dehra by Mr. J. B. N. Hennessey, F.R.S., that Dr. Tyndall's conclusion, from experimental evidence, regarding the high absorptive power of water-vapour compared to dry air, is true, though it has often been called in question by meteorologists.

Library.—The additions to the library have been few, and many of them are provincial departmental reports that have no connection with meteorology.

Cost of the Department.—A statement of the cost of the Department under various heads is appended below. The cost of buildings, charged to Provincial Funds, is rendered larger than usual

this year by a charge of Rs. 500 for a handsome thermometer shed and ornamental railed enclosure at the Muir College, Allahabad. The charge for travelling allowances, again, exceeded the Budget Estimate, which the Meteorological Reporter for India, I think, fixes too low, but the difference was made up by savings under other heads.

S. A. HILL, B.Sc.,
Meteorological Reporter to Govt., N.-W. P. and Oudh.

ALLAHABAD;
The 5th May, 1882.

APPENDIX B I.

Meteorological Observatory, Jeypore.

THE late Chief of Jeypore, who kept up, for about two years, at great expense, a meteorological observatory within the palace walls, desired to place the readings of his instruments at the disposal of Government.

The position selected by His Highness the Maharaja Sawai Ram Singh was in many respects unsuitable; the Council of the present Prince, therefore, decided to remove the establishment to a situation which would really represent the climatic conditions of (from a meteorological point of view) the unusually interesting country round the capital rather than those of the City of Jeypore, which stands in the entrance of a valley close to low hills.

The present site was selected by Mr. Hill, the Meteorological Reporter to the Government of the North-Western Provinces and Oudh. He considers that it fairly represents the Rajput country, and that the registers taken at the observatory will form a very valuable addition to the meagre data at present available for the elucidation of the meteorology of "Rajputana."

Readings of all the ordinary instruments are taken at intervals of six hours (4, 10, 16, 22 hours) every day, at hourly intervals, four times a month, and synoptic readings once a day, at 5h 5′ P.M., for the American Government.

The temperatures of the soil at the surface and at four different depths beneath it are also read four times a day.

A watchman's detector clock has been purchased, to secure the means of checking the punctuality of the Observers.

An improved Osler's anemograph has been erected in a turret adjoining the meteorological office. This instrument affords a continuous record of the velocity, force and direction of the wind, besides the rainfall.

The Government of India, on the recommendation of Mr. Blanford, has also agreed to transfer to Jeypore, at the cost of the Durbar, a Van Rysselberghe meteorograph, by which all the ordinary meteorological phenomena will not only be registered at intervals of ten minutes, but engraved on a thin metallic band, from which the values may be at once read off, and afterwards, by means of a copper-plate press, any number of copies may be printed for distribution. These results are obtained by the agency of electricity.

The instrument will probably be at work early in 1882, from which time the observatory will be one of the largest in India.

The Agency Surgeon has, for six years past, taken observations, which are comparable with those now registered.

Copies of all records are placed at the disposal of the Government of India.

The annual expenditure is Rs. 2,100.

The Van Rysselberghe instrument will cost about Rs. 4,000.

His Highness the Maharaja, by whose liberality the institution is supported, takes much interest in the daily register which is sent to him.

T. H. HENDLEY, SURGEON-MAJOR,
Superintendent, Meteorological Observatory, Jeypore.

APPENDIX B II.

Names of the Superintendents and of the Observers at the Meteorological Observatories in North-Western Provinces and Oudh, during the year 1881-82.

Observatory.	Class.	Officer in charge.	Date. From	Date. To	Observers.	Date. From	Date. To	Remarks.
Allahabad	Second...	S. A. Hill	1st April 1881	26th April 1881	Kedar Nath Chatterjee,[1] Observer	1st April 1881	31st Mar. 1882	
		W. N. Boutflower, Esq	27th April ,,	25th June ,,	Jadu Nath Chatterjee, Assistant Observer	Ditto ,,	Ditto ,,	
		S. A. Hill	26th June ,,	31st Mar. 1882				
Agra	Ditto ...	Dr. A. H. Hilson	1st April ,,	21st April 1881	Mir Altaf Ali,[1] Observer	Ditto ,,	Ditto ,,	
		Dr. A. Garden	22nd April ,,	25th Nov. ,,	Abdul Mufid Khan, Assistant Observer	Ditto ,,	Ditto ,,	
		Dr. A. H. Hilson	26th Nov. ,,	31st Mar. 1882				
Lucknow	Ditto ...	Dr. J. C. Whishaw	1st April ,,	6th Nov. 1881	Chotay Lal,[1] Observer	Ditto ,,	Ditto ,,	
		Dr. W. A. Cadge	7th Nov. ,,	19th Nov. ,,	Durga Parshad, Assistant Observer	Ditto ,,	Ditto ,,	
		Dr. J. C. Whishaw	20th Nov. ,,	31st Mar. 1882				
Roorkee	Ditto ...	Dr. Murray Thomson	1st April ,,	Ditto ,,	Chiranji Lal, Observer	Ditto ,,	Ditto ,,	
					Tulsee Ram, Assistant Observer	Ditto ,,	Ditto ,,	
Jeypore	...	Dr. T. H. Hendley	Ditto ,,	Ditto ,,	Durga Pershad, Observer	Ditto ,,	Ditto ,,	
					Gunga Ram, Assistant Observer	Ditto ,,	Ditto ,,	
					Nathu Narain, ditto	Ditto ,,	Ditto ,,	
Chakráta	Third ...	Major Crichton, R.E.	Ditto ,,	30th Nov. 1881	Saligram[1]	Ditto ,,	Ditto ,,	
		P. Mackenzie, Esq., C.E.	1st Dec. ,,	31st Dec. ,,				
		Captain A. E. Ward, B.S.C.	1st Jan. 1882	31st Mar. 1882				
Ránikhet	Ditto ...	No Superintendent	.....	.....	Jewa Nand[1]	Ditto ,,	5th Sep. 1881	
					Gunga Dutt	6th Sep. ,,	15th Oct. ,,	
					Jewa Nand	16th Oct. ,,	31st Mar. 1882	
Dehra	Ditto ...	J. B. N. Hennessy, Esq.	1st April 1881	31st Mar. ,,	The head Computers	1st April ,,	Ditto ,,	
Meerut	Ditto ...	Dr. W. P. Harris	Ditto ,,	14th July 1881	Harsaran Das	Ditto ,,	Ditto ,,	
		Dr. W. M. Courtney	15th July ,,	14th Oct. ,,				
		Dr. W. P. Harris	15th Oct. ,,	31st Mar. 1882				
Bareilly	Ditto ...	P. Kennedy, Esq.	1st April ,,	9th May 1881	Jwala Parshad	Ditto ,,	Ditto ,,	
		E. A. Phillips, Esq.	10th May ,,	31st Mar. 1882				
Gorakhpur	Ditto ...	Dr. C. Prentis	1st April ,,	10th April 1881	Sheo Lochun	Ditto ,,	22nd Aug. 1881	
		Dr. A. E. R. Stephens	11th April ,,	8th July ,,	Nizam-ud-din	23rd Aug. ,,	31st Mar. 1882	
		Dr. C. Prentis	9th July ,,	31st Mar. 1882				
Benares	Ditto ...	Dr. G. Thibaut	1st April ,,	Ditto ,,	Devakinandan Pathak[1]	1st April ,,	Ditto ,,	
Ghazipur	Ditto ...	Dr. P. A. Weir	1st Jan. 1882	.....	No observer			
Sutna	Ditto	Dr. S. J. Goldsmith	Ditto ,,	Ditto ,,	Harnath[1]	Ditto ,,	26th Feb. ,,	
					Ram Sahai	27th Feb. 1882	4th Mar. ,,	
					Harnath	5th Mar. ,,	31st Mar. ,,	
Nowgong	Ditto ...	J. Mather, Esq.	Ditto ,,	31st Mar. ,,	J. Mather, Esq.	1st April 1881	31st July 1881	
					Karim Bakhsh	1st Aug. ,,	31st Mar. 1882	
Jhánsi	Ditto	Surgeon G. M. Nixon	Ditto ,,	16th Dec. 1881	Kalkadas	1st April ,,	Ditto ,,	
		Surgeon-Major F. A. Smyth	17th Dec. 1881	23rd Mar. 1882				
		Surgeon G. M. Nixon	24th Mar. 1882	31st Mar. ,,				
Sambhar	Ditto	W. Foster, Esq.	1st April 1881	Ditto ,,	Mr. John Romare	Ditto ,,	Ditto ,,	
Ajmere	Ditto ...	Dr. J. H. Newman	Ditto ,,	Ditto ,,	Rampershad	Ditto ,,	Ditto ,,	
Pauri	Ditto ...	Revd. J. T. McMahon	June ,,	Ditto ,,	No observer	.....	.....	
Pithoragarh	Ditto ...	Revd. Dr. Gray	May ,,	Ditto ,,	Ditto	.....	.....	

[1] Admitted to the higher allowances sanctioned from April 1882.

APPENDIX B III.

Statement showing the Expenditure of the North-Western Provinces' Meteorological Department for the year 1881-82.

	Imperial Services.				Provincial Services.			Remarks.
	Establishment.	Contingencies.	Reporters' travelling allowance.	Total.	Establishment.	Buildings, &c.	Total.	
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
Meteorological Reporter .	3,000 0 0	...	551 11 0	3,551 11 0	...	...	...	
Ditto Office . .	2,520 0 0	*980 1 0	...	3,500 1 0	...	†66 11 0	66 11 0	
Allahabad Observatory . .	600 0 0	...	...	600 0 0	...	500 0 0	500 0 0	Rs. 500 sanctioned by the Local Government for the erection of a new shed at the Muir College.
Agra ditto . .	840 0 0	25 0 0	...	865 0 0	...	...	...	
Roorkee ditto . .	840 0 0	16 2 0	...	856 2 0	...	...	...	
Lucknow ditto . .	900 0 0	22 12 0	...	922 12 0	...	‡180 11 8	180 11 8	
Chakráta ditto . .	180 0 0	31 15 4	...	211 15 4	...	...	...	
Ránikhet ditto . .	180 0 0	...	...	180 0 0	...	...	...	
Bareilly ditto . .	180 0 0	14 12 9	...	194 12 0	...	...	...	
Gorakhpur ditto . .	180 0 0	2 8 0	...	182 8 0	...	...	...	
Benares ditto . .	180 0 0	29 15 9	...	209 15 9	...	...	...	
Jhánsi ditto . .	180 0 0	40 3 0	...	220 3 0	...	...	...	
Total .	9,780 0 0	1,163 5 1	551 11 0	11,495 0 1	...	747 6 8	747 6 8	

* Including office-rent and general contingencies of the Meteorological Office and Allahabad Observatory.

† For completing the observatory-shed at Pauri.

‡ For removing the anemograph to a better position.

APPENDIX B IV.

Results of Ground Temperature Observations at Allahabad.

Month.	Surface.				One foot deep.				Three feet deep.				Mean temperature.			
	4 hours.	10 hours.	16 hours.	22 hours.	4 hours.	10 hours.	16 hours.	22 hours.	4 hours.	10 hours.	16 hours.	22 hours.	Air in shade.	Ground surface.	One foot deep.	Three feet deep.
April 1881 . .	77·5	109·7	110·9	86·3	89·3	88·4	90·6	92·0	84·6	84·8	85·0	85·0	88·4	96·1	90·1	84·8
May ,, . .	83·0	112·4	112·5	90·6	95·8	95·0	96·7	97·6	90·8	90·9	91·1	91·0	91·8	99·6	96·3	90·9
June ,, . .	85·0	99·1	99·8	89·0	93·3	92·3	94·1	94·6	91·9	91·9	92·0	92·0	89·1	90·7	93·6	92·0
July ,, . .	82·3	90·1	90·0	85·0	87·3	87·0	87·8	88·3	88·2	88·5	88·6	88·5	84·3	86·8	87·6	88·4
August ,, . .	82·8	87·8	90·4	84·9	86·9	86·5	86·9	87·7	87·1	87·2	87·2	87·2	82·2	86·5	87·0	87·2
September ,, . .	81·8	89·8	92·0	84·7	86·9	86·5	87·7	87·9	87·3	87·4	87·4	87·3	83·1	87·1	87·2	87·4
October ,, . .	72·1	87·6	88·9	76·3	80·9	80·6	82·0	82·1	84·7	84·7	84·7	84·6	77·0	81·2	81·4	84·7
November ,, . .	57·7	75·0	79·2	62·7	70·2	70·0	71·4	71·6	77·6	77·6	77·7	77·6	65·1	68·6	70·8	77·6
December ,, . .	51·7	67·9	74·6	57·0	65·0	64·2	65·4	66·2	72·3	72·3	72·4	72·3	59·3	62·8	65·2	72·3
January 1882 . .	52·1	68·3	76·2	58·2	64·9	64·2	64·7	63·2	70·3	70·3	70·4	70·4	60·4	63·7	64·2	70·4
February ,, . .	56·0	74·3	80·9	62·3	68·5	67·5	68·7	70·0	71·8	71·9	72·0	71·9	64·1	68·4	68·7	71·9
March ,, . .	67·5	89·1	94·6	76·1	78·6	77·8	78·7	80·2	77·0	77·2	77·3	77·3	79·6	81·8	78·8	77·2

APPENDIX B V.

Results of Ground Temperature Observations at Jeypur.

Month.	Surface.				Four inches deep.				One foot deep.				Three feet deep.			
	4 hours.	10 hours.	16 hours.	22 hours.	4 hours.	10 hours.	16 hours.	22 hours.	4 hours.	10 hours.	16 hours.	22 hours.	4 hours.	10 hours.	16 hours.	22 hours.
August 1881 . .	80·2	80·6	86·5	81·7	79·9	80·7	85·5	83·3	82·7	81·7	84·1	84·6	83·6	83·7	83·7	83·6
September ,, . .	Untrustworthy.				82·5	82·5	89·5	86·6	84·8	83·4	86·9	87·7	84·9	85·0	85·0	85·0
October ,, . .	Ditto.				79·9	80·0	90·0	84·7	82·7	81·0	85·1	85·5	84·9	84·9	85·0	84·9
November ,, . .	55·9	75·9	84·7	82·8	65·3	66·0	77·5	70·9	70·0	68·7	72·1	73·2	77·0	73·9	77·3	77·1
December ,, . .	52·0	68·5	74·4	57·3	59·4	60·0	69·6	63·8	61·3	61·9	64·7	65·5	69·9	69·9	70·1	70·0
January 1882 . .	48·3	70·9	72·0	53·3	56·3	59·6	71·3	61·6	61·4	59·7	63·3	64·4	65·4	65·4	65·5	65·6
February ,, . .	49·7	80·3	90·4	55·2	58·6	63·2	82·8	66·1	64·2	62·2	66·7	68·2	66·6	66·9	66·9	66·9
March ,, . .	57·9	100·9	109·2	65·1	69·8	78·0	96·4	78·6	75·1	73·6	77·8	79·4	73·2	73·3	73·5	73·4

Results of Ground Temperature Observations at Jeypur—(concluded.)

Month.	Ten feet deep.				Twenty feet deep.				Mean Temperature.						
	4 hours.	10 hours.	16 hours.	22 hours.	4 hours.	10 hours.	16 hours.	22 hours.	Air in shade.	Ground surface.	Four inches deep.	One foot deep.	Three feet deep.	Ten feet deep.	Twenty feet deep.
August 1881 . .	83·3	83·4	83·3	83·6	...	...	...	...	80·4	82·2	82·4	83·3	83·6	83·4	...
September ,, . .	83·3	83·3	83·3	83·3	...	...	...	...	81·2	?	85·3	85·7	85·0	83·3	..
October ,, . .	83·9	83·5	83·8	83·8	...	...	...	...	78·8	?	83·6	83·6	84·9	83·8	...
November ,, . .	82·6	82·6	82·6	82·6	...	...	...	...	66·1	74·8	69·9	71·0	76·3	82·6	..
December ,, . .	78·9	79·3	79·2	79·2	...	...	...	...	62·1	63·0	63·2	63·2	70·0	79·2	..
January 1882 . .	73·7	73·7	73·7	73·6	79·7	79·7	79·8	79·7	60·3	61·1	62·2	62·2	65·4	73·7	79·7
February ,, . .	72·9	72·9	72·8	72·8	79·9	78·9	78·9	78·9	62·4	68·9	67·7	65·3	66·8	72·8	78·9
March ,, . .	72·9	72·9	72·9	72·9	78·1	78·1	78·1	78·1	76·2	83·3	80·7	76·5	73·4	72·9	78·1

APPENDIX C.

Administration Report of the Meteorological Reporter to the Panjab Government for 1881-82.

There has been no change in the method of taking observations during 1881-82, and the number of observatories in the Panjab has remained unaltered.

All the observatories and observers were fully supplied during the year with clocks and watches, so that there was no excuse for mistakes or neglect in observing punctuality in the time of registering observations.

File and copy-books were issued to all the observatories during 1881-82, as considerable inconvenience had been experienced in previous years, owing to the observers being frequently changed, in the preservation of official records.

2. Besides the routine work of my office, monthly Meteorological abstracts have been sent to the Sanitary Commissioner, as well as a Meteorological report to the Panjab Government. Several statements were from time to time supplied to local officers, and the observations taken at Lahore were published every day in the *Civil and Military Gazette*. The whole of the work has been satisfactorily performed by my clerks, who are also the observers of the Lahore observatory.

3. The status of the observatories remains the same as last year. Ten are third-class, and one, the Lahore observatory, is second-class. Lahore ought undoubtedly to be a first-class observatory. The position of the present observatory is very faulty, but it is hoped that a better site will be secured for it when the new medical school buildings are completed.

4. It is much to be regretted that it has not yet been thought advisable to furnish the Lahore observatory with Van Rysselberghe's Meteorograph. This instrument, which was specially sent out from home for this observatory two years ago, would probably be of great service in a station like Lahore; but it has not yet been supplied to the observatory, because the Government of India is doubtful if any one on the spot has sufficient practical acquaintance with the management of delicate mechanisms and electric batteries. I am confident, however, that this is not a difficulty which should necessitate the postponement of the question for future consideration, and, under any circumstances, it appears to me that the instruments would suffer less by being brought into use here, than by being kept in store in Calcutta.

5. During August and September 1881 I inspected all the observatories in the Province, except Dera Ismail Khan and Mooltan. I had intended to visit these in the cold weather, but as they were inspected by Mr. Eliot in November, any further inspection by me so late in the year did not seem necessary.

6. At Rawalpindi I found the shed built well, and according to pattern, and in very good order. The instruments were neither well kept nor clean. The wind-vane stand was not firm, and the observer was directed to have it made so. The observer at this station gave much trouble during the year and neglected to maintain accuracy in his observations.

7. The observatory at Murree was found, as it invariably is, in capital order, and all the records and observations kept with great care and neatness. It is always a pleasure to visit this observatory. Its condition reflects the greatest credit on Mr. Cruickshank and his predecessor Mr. Johnson; though, without disparagement to these gentlemen, I am convinced that it is to a great extent due to the constant interest in it displayed by the Principal of the Lawrence Memorial Asylum, who is the Honorary Superintendent.

8. The observatory at Sialkot is under the charge of Assistant-Surgeon Fatteh Singh, who has the reputation of being a careful and trustworthy observer. The shed is in a faulty position, and the rain-gauge was too close to it. The instruments were in good order and clean at the time of my visit. The wind-vane was not fixed, and the ladder, which leads to the roof on which it is placed, was in a most unsafe condition. I ordered this to be replaced by a staircase and rail. This ought to have been done long ago, as it appears to me totally impossible that the Assistant-Surgeon, who is the observer in charge, could have gone through the break-neck performance, of climbing on to the roof twice a day, by the ladder in the condition I found it: and it is quite obvious that if he did not, the observations reported have been worthless.

9. At Peshawar, I found the records kept very neatly. The observer has given satisfaction during the year, by the accuracy of his observations. I found the shed small, and not made according to pattern. The barometer was an old one and kept in the verandah. The rain-gauge was at the Jail, a long way off the observatory. The instrument-cage was too high. A new barometer was supplied, and all the defects above noticed remedied, except that a new shed has not hitherto been put up, as the estimate for it was so high, *viz.*, Rs. 500, that it was out of the question. It is

expected that a very much less cost will suffice for its erection, and Dr. Coates, the Civil Surgeon, is at present engaged in an endeavour to arrange for it.

10. At Ludhiana I found all the records and instruments-shed, &c, in good order. The Assistant-Surgeon is well known to me as a man of intelligence, but I had to find fault with him, with regard to the time of registering observations.

The observatory clock was not going when I made my visit, and had not been for some time, and the observer was unable to afford any explanation of the way in which he observed punctuality in its absence.

11. At Delhi, I found that the shed was at least a foot too low. The stand of the anemometer was unfixed. With the exception of these and a few other trifling defects, which were remedied during my visit, I found everything in the observatory in fair order, and the records well kept.

12. At Sirsa, I found all the instruments, except the rain-gauge, in good order. The anemometer was in the wrong position on the roof of the shed, and I ordered it to be removed to the top of the Jail Office. The rain-gauge was out of order, and was replaced by a new one, and a number of petty repairs were effected during my inspection visit. The shed itself was in a most tumble-down condition, and was condemned, and has since been re-constructed on a new and better site selected by Mr. Eliot.

13. Simla was the last observatory inspected. The instruments were found well kept, clean and in good order. The observer had only recently been appointed, and was not aware of the proper method of setting the instruments. He was also not clear about the time of registering observations.

All this was fully explained to him, and his work since has been good and trustworthy.

14. From the above brief report of my inspection of the observatories in the Punjab, it is apparent that, at the time of my visit, the instruments and appliances were generally in fair order. I doubt, however, whether it is safe to infer from appearances at an inspection visit, that the work of the observatories is carried on in a manner to make the observations recorded really trustworthy as a basis for deductions.

At my visit, I noticed many little points, in several of the observatories, which were in themselves trifling, but which raised a doubt in my mind as to the trustworthiness of the work performed by the observers in charge. For instance, in one or two, the wind-vane was not fixed; in many others, the pad for the grass-thermometer was out of repair; and, in more than one, the means of getting at such of the instruments as were placed on the roofs of buildings, consisted of nothing more than a rotten ladder, which was in much too dangerous a condition to admit of its being used for the purpose for which it was intended. Moreover, I found, on careful enquiry, that carelessness about time was very common at many of the stations, and that the loosest ideas prevailed generally about the importance of punctuality in registering observations.

At one station on the line of railway, the observer had the audacity to inform me that he was in the habit of setting his clock, which was not going when I visited the observatory, by the whistle of the engine, which comes in daily with the half-past 2 train from Lahore.

Finally, I have been informed that it is not uncommon for the observers who draw the pay, 15 rupees a month, of the appointment, to hand over to one of their subordinates in the dispensary, or even to one of the servants, 2 or 3 rupees a month to take observations for them.

The reason of all this appears to me to be that, though lots of money is spent on it, the Meteorological Department is practically starved. The Superintendents of the observatories are hard-worked Civil Surgeons, who get no extra pay for the appointment, and who are frequently changed. At Delhi, for example, the Superintendent was changed four times during 1881; and at Sialkot and Dera Ismail Khan, no less than six times. On the other hand, the observers are usually Assistant-Surgeons or Native Doctors who have their official work and private practice to look after. It is a very great tie, indeed, to have to register observations at two fixed times every day, all the year round; and it is too much to expect men of this class to do this and the other work of the observatories for 15 rupees a month.

In my opinion, 50 rupees a month would not be more than enough to ensure carefulness, and create an interest in Meteorology on the part of men of the Assistant-Surgeon class; and if this sum cannot be granted, it would be much better to train an inferior class of men to perform the Meteorological work.

Many such men are to be found about every dispensary, in the compound of which the observatory is generally situated, such as the clerk or compounder, who are constantly on the spot, and to whom an addition of 15 rupees a month salary would be a real gain and sufficient to ensure punctuality and all the other essentials required in an observer, by the head of the Meteorological Department.

15. Mr. Eliot, Officiating Meteorological Reporter to Government of India, inspected the Panjab observatories in December 1881, and his reports were, in every instance, extremely satisfactory.

A list of Superintendents and Observers in charge of the observatories is appended, as well as a list, showing the breakages of instruments which occurred during the year.

ED. LAWRIE, M.B.,

Meteorological Reporter for Panjab.

LAHORE;

The 23rd May 1882.

APPENDIX C I.

List showing the Names of the Superintendents and Observers at the Meteorological Observatories in the Province of the Panjab during the year 1881-82.

Observatories.	Class.	Names of Superintendents.	Period. From	Period. To	Observers.	Period. From	Period. To	Allowance.	Meritorious allowance intended for 1882-83.
LAHORE	II	Dr. Ed. Lawrie, M.B., Meteorological Reporter to Government, Panjab	Throughout.		Babu Jasput Rai, Head Clerk, Meteorological Office	Throughout.		20	...
					Babu Divan Chand, 2nd Clerk, Meteorological Office			10	...
DELHI	III	Surgeon-Major A. Taylor	1st April	19th Oct.	Asst.-Surgeon. Ram Kishen	1st April	28th Dec.	15	...
		,, ,, R. E. Wrafter	20th Oct.	25th Oct.	,, ,, Radha Kishen	29th Dec.	31st Mar.		
		Dr. J. Ferguson	26th Oct.	2nd Nov.					
		Surgeon-Major G. Ross	3rd Nov.	31st Mar.					
LUDHIANA	III	R. Rouse, Civil Surgeon	Throughout.		Asst.-Surgeon Bhugwan Dass	Throughout		15	...
MULTAN	III	R. Gray, ditto	Ditto.		Babu Wahid Ally Shah	Ditto		15	5
DERA ISMAIL KHAN	III	Dr. R. J. Taaffe	1st April	8th April	Hospital Assistant Noor Bukhsh	1st April	31st Oct.	15	...
		,, H. Haig	9th ,,	1st June	,, ,, Sher Baz	1st Nov.	30th Nov.		
		,, G. B. Davis	2nd June	16th ,,	,, ,, Noor Bukhsh	1st Dec.	31st Mar.		
		,, P. Haig	17th ,,	14th Sep.	.....	.....	.....	...	...
		,, G. B. Davis	15th Sep.	12th Dec.					
		,, R. J. Taaffe	13th Dec.	31st Mar.					
SIRSA	III	Asst.-Surgeon Fatteh Singh	1st April	13th April	Hospital Assistant Fuzalr Rahman	Throughout		15	5
		Dr. R. Crossby, C.S.	14th ,,	31st Mar.					
		,, A. M. Crafts	1st April	22nd July					
		,, G. V. Currie	23rd July	4th Sep.					
SIALKOT	III	Asst.-Surgeon Fatteh Singh	5th Sep.	18th ,,	Babu Surdar Khan, Dispensary Clerk	1st April	30th April	15	...
		Dr. A. M Crafts	19th ,,	27th ,,	Asst.-Surgeon Fatteh Singh	1st May	31st Mar.		
		Asst.-Surgeon. Fatteh Singh	28th ,,	17th Nov.					
		Dr. Thomas S. Veale	18th Nov.	31st March					
MURREE	III	R. E. Peak, Principal, L.A.	Throughout.		R. Johnson	1st April	17th Oct.	15	...
					Mr. Cruickshank	18th Oct.	31st Mar.		
SIMLA	III	Quarter Master General	Ditto.		C. M. Peart	Throughout		15	...
PESHAWAR	III	Surgeon T. E. L. Bate	1st April	20th Aug.	Hospital Assistant Kashi Ram	Throughout		15	5
		,, K. M. Dowine	21st Aug.	30th Sep.	.....				
		,, T. E. L. Bate	1st Oct.	12th Nov.	.....				
		,, W. Coates, M.D.	13th Nov.	21st Dec.					
		,, T. E. L. Bate	22nd Dec.	31st Mar.					
LEH	II	N. Elias, Joint-Commissioner	Throughout.		Hospital Assistant Sarfiraz Khan	1st April	30th Nov.	20	...
					Hera Lal, Assistant-Surgeon	1st Dec.	31st Mar.		
					Bhola Nath, Assistant Observer	Throughout		15	...
RAWAL PINDI	III	.....	.....		Bhawani Dass, Asst.-Surgeon	1st April	24th Jan.	15	...
					Jaggan Nath, ditto	25th Jan.	31st Mar.		

LAHORE;
The 23rd May 1882.

ED. LAWRIE, M.B.,
Meteorological Reporter for Panjab.

APPENDIX D.

Report on the working of the Observatories in the Central Provinces during the year 1881-82.

During the year 1881-82 there were no changes in the number or class of observatories in the Central Provinces.

SECOND-CLASS OBSERVATORIES.

Nagpur.—This is the only one which I have had an opportunity of visiting. I arrived at the observatory, unexpectedly, about 6 A.M., and found only the Assistant present. He had just noted the reading of the grass radiation thermometer. I found the wire-fence round the enclosure broken, and in the state, in which, it then was, cattle could easily make their way into it at several points. The Superintendent afterwards informed me that the fence was in good order a couple of days before my visit.

The thermometer-shed, built on the usual plan, was in good repair, and the thermometers clean, properly hung, and in order; and the directions laid down for changing the muslin and wick attached to the wet bulb thermometer carefully carried out. A small tumbler is used as a receptacle for the water, instead of a narrow-necked bottle. Rain-water is exclusively used. The Assistant was putting out the solar radiation thermometer at the time of my visit, under the impression that exposure from sun-rise to sun-set was necessary. On examination, I found a small portion of the mercurial column, about a degree, detached at the upper end of the tube. I am not aware whether allowance is made for this or not, but have addressed the Superintendent on the subject.*

* I have since ascertained that no allowance has hitherto been made for this, in recording the observations.
B. S.

The barometer was properly hung and in working order. An anemograph-tower has been constructed by the Public Works Department, at a cost of Rs. 639-3. It has, however, been erected within about 10 feet of the pukha masonry platform, on which the wind-vane and anemometer are placed, and overtopping them to a considerable height, and, I should say, rendering the observations of these comparatively valueless. I have been unable to ascertain who is answerable for this. There is a clock in the office, which I found, at the time of my visit, was accurately kept to local time. The chief defect in the arrangements at this observatory is, that the observer himself is non-resident, and seldom arrives before 10 A.M. This, however, is, under existing circumstances, unavoidable, there being no sort of accommodation nearer than Nagpur, which is about 2 miles distant.

Jubbulpore.—From Jubbulpore the Superintendent reports that "the barometer was removed from its old site in the Central Jail to the office room of the new Civil Branch Dispensary; the index point in the latter station is 10 feet 7 inches lower than before; its present level, therefore, 1340·75 above mean sea-level, and the first reading was made at 10 hours of 8th April 1881."

The Superintendent states that the thermometer-shed requires extensive repairs, none having been executed since 1879. The anemometer and wind-vane require to be raised 15 feet, as some trees in the neighbourhood are beginning to influence the westerly and north-westerly winds, though so far, only slightly; on the trees increasing in size, the effects will become more and more decided.

Pachmarhi.—At Pachmarhi the position of the barometer was changed from 12th March 1882, the observatory building being under re-construction.

THIRD-CLASS OBSERVATORIES.

Chanda.—The barometer was removed temporarily, in December last, to another room, whilst the one in which it was permanently kept was under repair. The grass radiation thermometer was broken during a violent storm.

Saugor.—A post for the wind-vane and anemometer was erected at a cost of Rs. 261. No other alterations took place.

Hoshangabad.—The barometer was put out of use temporarily, on 27th March 1882.

Khandwa.—A wet minimum thermometer was received on the 20th July 1881, supplied from the Sanitary Commissioner's office store.

Seoni.—The rails round the thermometer-shed were repaired; a new anemometer, No. 518, brought into use on 3rd June, and a wet minimum thermometer supplied from the Sanitary Commissioner's office store on the 29th November 1881, to replace No. 3495, which the Superintendent reports was broken in the process of cleaning, by the Assistant. He remarks that "these thermometers are very liable to be broken at his observatory, owing to the frequent necessity to clean the bulb from the lime so abundantly deposited from the water." This appears to me to be a most unsatisfactory explanation. There can be no excuse for not using rain water; neither the Superintendent nor observer seem to have studied the simple directions laid down in the Manual.

Raipur.—With the exception of re-roofing the thermometer-shed, and slightly raising the eaves, no alterations appear to have been made in the building.

Grass radiation thermometer No. 38447, and barometer 8-1878, by Adie, were both broken during the year, and new instruments, in consequence, substituted. No satisfactory account has been given by the Superintendent as to the cause of the breakage. In the case of the thermometer, he says its appearance indicated that it was broken by a stone; but neither he nor the observer seem to be able to state whether any stone was noticed near it; the enquiry does not seem to have been a very searching one.

Sambulpur.—The present shed has been in use since 1879. With the exception of a masonry, building. pillar for a sun-dial, and the usual annual repairs, no alterations are reported in the observatory

A compass, No. C-69 and sun-dial, No. S-62, were supplied during the year.

The Superintendent reports that the present meteorological shed, which is situated in an open space, 66 yards distant from the Jail wall, will have to be removed, as the Jail is to be enlarged, the extension coming up close to it, will seriously affect the observations.

Sironcha.—No alterations were made to the buildings during the year.

CONDUCT AND QUALIFICATIONS OF OBSERVERS.

The Superintendents of the Hoshangabad and Chanda Observatories have sent in no report under this head.

The Superintendent of the Jubbulpore Observatory has reported, in very unsatisfactory terms regarding two of his observers. One resigned on 28th February last, on hearing that it was intended to remove him. He was relieved by Babu Banikanta Roy Chowdry, transferred from the Meteorological Office, Bengal. This man has worked most unsatisfactorily, exhibiting great want of energy and punctuality in the performance of his work. He has pleaded illness as the cause, but the Civil Surgeon is unable to confirm his statement.

The Superintendent of the Saugor Observatory reported, on the 7th of April last, in answer to enquiries from this office, that both the conduct and qualifications of his observer were "very good." The words are in the Superintendent's own handwriting. I am at a loss to understand why Dr. Strong should have recorded such remarks, after the receipt of letter No. 500, dated 18th March 1882, from the Meteorological Reporter to the Government of India, a copy of which was forwarded to him in due course, and in which the Reporter ordered the immediate dismissal of the Observer, as being utterly untrustworthy.

As I have only been in charge of this office since the 3rd of April last, I regret I am unable to offer any remarks from personal knowledge, or observation, on the working of any of the observatories in these Provinces, with the exception of Nagpur. I regret this the more, as my predecessor has left no notes of his inspections to guide me in drawing up a report on the subject. Such particulars as are given are gleaned from letters received from the Superintendents of the several observatories.

The usual statements will be found annexed.

B. SIMPSON, M.D.,
Deputy Surgeon General and Sanitary Commr.,
Central Provinces.

NAGPUR;
The 27th May 1882.

APPENDIX D I.

Names of the Superintendents and of the Observers at the Meteorological Observatories in the Central Provinces during the year 1881-82.

Observatory.	Class.	Officer in charge.	Date. From.	Date. To	Observer.	Date. From.	Date. To.	Remarks.
Nagpur	2nd Class	Surgeon H. M. Leckler	1st April 1881	5th June 1881	*Observer.*			
		Major H. A. Hammond	6th June ,,	21st Nov. ,,	T. V. Allagherri Swamy	1st April 1881	31st March 1882	
		Surgeon-Major R. T. Wright, M.D.	22nd Nov. ,,	28th Jan. 1882	*Assistant Observer.*			
		F. C. Berry, Esq.	29th Jan. 1882	7th Feb. ,,	P. Soobiah	1st April ,,	31st March ,,	
		Surgeon-Major R. T. Wright, M.D.	8th Feb. ,,	31st March ,,				
Jubbulpore	Ditto	,, ,, W. R. Rice, M.D.	1st April 1881	31st March ,,	*Observer.*			
					Prasanna Kumar Basu	1st April ,,	28th Feb. ,,	
					Bankanta Ray Chowdhury	1st March ,,	31st March ,,	
					Assistant Observer.			
					2nd Class Hospital Assistant Koonja Behari Lall	1st April ,,	31st March ,,	
Pachmarhi	Ditto	R. H. Finch, Esq.	1st April ,,	31st March ,,	*Observer.*			
					Madho Rao	1st April ,,	31st March ,,	
					Assistant Observer.			
					Narain Bhagwant	1st April ,,	31st March ,,	
Saugor	3rd Class	Surgeon-Major J. W. Strong	1st April ,,	31st March ,,	*Observer.*			
Hoshangabad	Ditto	Surgeon S. H. Browne, M.D.	1st April ,,	26th April 1881	Deendayal Pathuck	1st April ,,	31st March ,,	
		,, G. R. Daphtary, M.D.	27th April ,,	26th July ,,				
		,, S. H. Browne, M.D.	27th July ,,	31st March 1882	Jadu Nath Bose	1st April ,,	31st March ,,	
Khandwa	Ditto	Surgeon-Major P. Cullen, M.D.	1st April ,,	31st March ,,	Biharilal Parasar	1st April ,,	31st March ,,	
Seoni	Ditto	,, ,, J. B. Gaffney	1st April ,,	31st March ,,	Punchum	1st April ,,	31st March ,,	
Chanda	Ditto	Assistant-Surgeon Umesh Chandra Mitter, M.B.	1st April ,,	5th May 1881				
		Mr. M. Craggs	6th May ,,	12th Oct. ,,				
		Assistant-Surgeon Umesh Chandra Mitter, M.B.	13th Oct. ,,	29th Dec. ,,	Seeta Ram	1st April ,,	31st March ,,	
		Surgeon H. Armstrong	30th Dec. ,,	31st March 1882				
Sironcha	Ditto	Assistant-Surgeon Harran Chandra Dutt	1st April ,,	31st March ,,	1st Class Hospital Assistant P. Moothoo Krishna Naidoo	1st April ,,	17th Jan. ,,	
Raipur	Ditto	Surgeon-Major D. W. Trimnell	1st April ,,	31st March ,,	Assistant-Surgeon Harran Chander Dutt	18th Jan. 1882	31st March ,,	
Sambalpur	Ditto	Honorary Surgeon G. E. Harrison	1st April ,,	31st March ,,	Krishna Rao	1st April 1881	31st March ,,	
					Shamsoonder Dass	1st April ,,	31st March ,,	

APPENDIX E.

Extracts from a Report on the Administration of the Meteorological Department of Western India for the year 1881-82.

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STORM-WARNING SERVICE.

2. This service has been carried on on the same footing as in the previous year. Regular daily telegraphic reports were received from all the following stations, except Calicut, which sends no reports on Sundays:—

Karachi.	Calicut.
Surat.	Cochin.
Ratnagiri.[1]	Negapatam.
Karwar.	Madras.
Mangalore.	Masulipatam.

The Colaba observatory, Bombay, also furnished regular daily reports. As soon as the Code Messages arrive, they are translated into their corresponding instrumental readings, which, after correction and reduction, are curved, charted, and entered in a tabular daily report, a copy of which is usually ready before 4 o'clock in the afternoon, except on Sundays, when the closing of many of the telegraph offices, at certain hours, delays the report till about 7 hours 30 minutes P.M. These reports are prepared merely for office use, and are not published, except in an indirect way; the Port Officer sending his messenger to the office daily for a copy of the report, and permitting the Editor of the *Times of India* to copy and publish it whenever he finds it convenient to do so. Extracts from the report are also given to the Editor of the *Bombay Gazette*, who sends a messenger to the office for the information, and occasionally publishes it in the paper. The full significance of the details entered in these reports can only be seen, even by a professional meteorologist, after the processes of curving and charting have been gone through. * * * * * *

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4. Four additional storm-signal stations have been established during the year, *viz.*, Goa, Daman, Bhavnagur Creek, and Bhavnagar Bandar. The complete list now includes sixteen stations, as shown below:—

Storm-Signal Stations.

Principal Stations.	*Subsidiary Stations.*
Karachi	.....
Bhavnagar Bandar	Bhavnagar Creek.
Daman	.....
Bombay Castle	Prince's Dock, Colaba Point, (*a*) Kenneri.
Ratnagiri	.....
Vengurla	Vengurla Rocks, (*a*) Malvan.
Aguada Head, Goa	.....
Karwar	Oyster Rock Light-house, Karwar.
Kumba	.....

All the stations were furnished, in September and October last, with cones and lanterns, for making the signals, and placards, printed in large type describing the character and meaning of the signals, have been distributed to the various ports.

5. Telegraphic communication between the Meteorological Office and the Central Telegraph Office has not yet been established, but it is understood that the connection will shortly be made by the Telegraph Department. The contemplated revision of the Meteorological Telegraph Code also still remains to be carried out, and the grave defect referred to last year, *viz.*, the absence in the Code

[1] Reports commenced on the 27th May 1881.

of any provision for affording information as to the velocity of the wind at the time of observation is still seriously felt. Since the 1st of January 1882 the revised Telegraph Rules have permitted the transmission of eight words at the same cost as six, the number used in the Meteorological Code; but I have been prevented from utilising the two additional words, for the purpose of obtaining the telegraphic transmission of the wind velocity, by the consideration that confusion might thus be introduced into the general telegraphic work of the Indian Meteorological Department.[1] The total movement of the wind during the preceding twenty-four hours is given by the use of the present Code; but this intelligence is far less informing than the actual velocity of the wind at the hour of observation, and is, besides, at best, twelve hours older than most of the other information afforded by the daily telegrams.

6. The past year was an eventful one with regard to storms. Between May 27th and June 3rd, a most terrific cyclone crossed the Arabian Sea, from east to west, but in no part of its course was it sufficiently near the West Coast of India to produce violent winds on land, although a tremendous swell was felt at almost every reporting station along the coast. With the assistance of Captain Morland, Port Officer, Bombay, a great number of ships' logs have been collected from vessels that were either involved in, or were in the neighbourhood of this cyclone. In one of these logs is recorded a barometric reading of 27·3 inches, at which point the index was stopped by the thermometer attached to the instrument, so that even this low reading does not give the actual minimum pressure of the cyclone.

7. Another cyclone, accompanied by heavy rainfall, passed over Kathiawar and Cutch on the 12th and 13th July, causing great destruction of house property. It also raised the force of the monsoon wind, between Surat and Bombay, to a violent gale, wrecking a mail-boat in the Gulf of Cambay, and disabling the S. S. *Calder*, which had to put back to Bombay under the greatest difficulty, after having had some of the deck passengers washed overboard. No intimation of the existence of this cyclone reached the Meteorological Office, until after office hours, on the 12th. The regular daily telegrams of the 11th showed no indication of it, except that the barometer had fallen slightly at Surat; but as there was an error in the Surat telegram, even this slight indication could not be relied on. A repetition of the message was at once called for, and special reports were, at the same time, demanded from several other stations, including Rajkot, which, as afterwards appeared, was, on the 12th, near the centre of the disturbance; but no information reached the Office, in time, to permit of the announcement, in the reports of the 12th, of the fact that a cyclone was then passing over Kathiawar. * * * * * * * * *

8. Another cyclonic disturbance occurred between the 11th and 17th November 1881. The centre of the barometric depression passed in a north-westerly direction, between Madras and Negapatam, over the Peninsula, to Goa, and onward over the Arabian Sea, to the west of Karachi. The first decided indications of this November storm were noticed in the daily telegraphic reports of the 12th, when special reports from additional stations were at once called for; but the additional information did not arrive in time to permit of warning-telegrams being issued to the Ports to the southward of Bombay, till the afternoon of the 13th, when the storm had already reached Goa. The fact that it had done so was not known at the Meteorological Office, however, till after office hours on the 13th, more than twenty-four hours having elapsed before the arrival of any of the special information called for on the afternoon of the 12th from Goa. The warning signals were hoisted at Bombay and Bhavnagar on the morning of the 14th November; but though the influence of the cyclone was decidedly noticeable in the veering of the wind, in the cloudy sky, and in other meteorological changes, the centre of the disturbance appears to have passed out to sea without coming sufficiently near to Bombay to cause the wind to blow with violence; and the signals were lowered on the following morning.

* * * * * * * * * *

10. Strong abnormal winds from south-south-east, of about 30 miles per hour, have been felt at Bombay, on several occasions, since the Storm-warning System was established, without any indications of rough weather having been observable in the barometric data furnished by the regular daily

[1] See text of the General Administration Report, page. —H. F. B.

reports. The most remarkable of these disturbances occurred on the 22nd and 23rd October 1880, the 7th and 8th and the 29th and 30th of May 1881, and the 6th November 1881. On each of these occasions the abnormal wind blew for the whole of the day, with an average velocity of more than 20 miles per hour * * * * * *

These instances, and the cyclone of May 1879, make it seem probable that cyclones impinging against the Western Ghauts are much flattened and intensified on the side nearest the hills, and if this be so, it is easy to see that the barometric gradient between Bombay and Poona may undergo a sudden change of value, and perhaps of sign, at the line of the Ghauts, in which case, the difference between the sea-level values of the barometric pressure at Bombay and Poona will afford no measure of the magnitude of the gradient between Bombay and the foot of the Ghauts. The only way of meeting this difficulty, would be to arrange for barometric observations being taken at stations near the foot of the Ghauts, at Karjat and Vasind, for instance. The observations would have to be made with extreme accuracy, on account of the shortness of the direct distance between Bombay and those stations.

11. The following Statement shows the dates of all the special telegraphic weather reports received from those stations that send reports only when specially called upon to do so. It also shows the occasions when special cautionary or assuring telegrams were sent to the Port Officers of Bombay and Karachi; and also the stations to which warning telegrams, ordering the storm-warning signals to be hoisted, were issued during the year :—

Dates for which special observations were called for.	Dates when cautionary or assuring telegrams were issued to the Port Officers at		Stations to which telegraphic orders to hoist the storm signals were issued.	
	Bombay.	Karachi.	Station.	Date.
1881, May 11th to 15th	1881, May 12th	1881, May 31st	Ratnagiri	
„ July 10th to 14th	„ July 3rd	.....	Vengurla	
„ August 3rd to 7th	„ „ 6th	.....	Goa	1881, November 13th
„ November 11th to 17th	„ „ 13th	„ July 13th	Karwar	
1882, January 9th to 13th	„ November 8th	.....	Kumba	
„ March 20th to 24th	„ „ 12th	„ „	.....	
	„ „ 13th	.....	Bombay	„ „ 14th
	„ „ 14th	„ November 14th	Bhavnagar	
	„ „ 16th	„ „ 16th	.....	

OBSERVATORIES.

12. The number of observatories remains the same as in the previous year, *i.e.*, twenty-three; none having been suppressed, and no new ones having been established during the year. The observatory at Zanzibar has, however, been raised from the voluntary to the permanent scale, and a paid observer, who commenced his duties on the 1st January 1882, has now been provided for it. From April to December 1881, the observations were taken very accurately and regularly by Dr. Robb, and the Department is much indebted to him for the interest he has taken in the work, and for the devotion with which he has personally maintained the continuity of the Meteorological record at that important station. A list of the observatories, showing the names of the Superintendents and of the observers who have held office during the year, forms Appendix I.

13. At several of the observatories there have been interruptions of the continuity of the registers, as indicated below, varying from one to four months, chiefly owing to sickness of the observers or to their absence on duty connected with their primary appointments in the Medical Department;

and it is not easy to see how these interruptions of the work can be prevented under existing circumstances:—

Interruptions in the registers.

Station.	From.	To.
Jacobabad	28th December 1881	3rd January 1882.
Bickaneer	17th January 1882	8th February 1882.
Hyderabad	1st April 1881	2nd May 1881.
Karachi	1st December 1881	2nd January 1882.
Mount Abu	16th June 1881	14th October 1881.
Mount Abu	8th February 1882	18th March 1882.
Rajkot	8th December 1881	5th February 1882.
Rajkot	22nd February 1882	31st March 1882.

The above list includes all the cases of total interruption of the records for more than a day or two, but does not include partial interruptions arising from derangements or breakages of instruments.

14. Three of the observatories, *viz.*, those at Deesa, Belgaum and Poona, are now furnished with self-recording anemometers, which are of the large Robinson-Beckley Pattern at the two former stations, and of the embossing pattern, by Casella, at the latter. The Deesa instrument has worked well throughout the year. Valuable traces have been obtained from that at Belgaum, from June 1881, and the instrument has been in perfect working order since October 1881. The Poona embossing instrument has given less satisfactory records on all days when there were no calms, but whenever calms occur the record is almost valueless. Arrangements are being made for the erection of another of these embossing instruments at Ratnageri in the hope that it may afford valuable information for the Storm-signal Service.

Inspection of Observatories.

15. No observatories have been inspected during the year, the working of the new Storm-signal Service having kept me in Bombay, and no arrangements having been made for carrying on this work during my absence on inspection duty.

METEOROLOGICAL ERECTIONS.

16. No new erections have been constructed during the year, the only works executed having been of the nature of petty repairs to the thermometer-sheds, fences, &c.

INSTRUMENTS AND THEIR VERIFICATION.

17. The following table shows the number of instruments issued, and the observatories to which they were sent:—

[*The Return of the Instruments issued to Meteorological Observatories in 1881-82, which here follows, has been included in the General Return at page of the General Report.*]

The above instruments were all verified at Bombay before being despatched to the respective stations. Of the five barometers, three were issued to supply the place of others that had become unserviceable by leakage, one in lieu of an instrument that required cleaning, and one as a duplicate, to test the accuracy of the instrument in regular use. Though less than in previous years, the destruction of grass-radiation thermometers has been very great, especially as compared with that of solar thermometers. Some of the former are said to have been broken by dogs or other animals, and the woollen pads on which the grass thermometers are exposed to have been torn to pieces; but more frequently the breakage report states that the instrument was found broken without any apparent cause, and it is clear that the grass thermometers are subject to sources of destruction which do not, to the same extent, affect the solar thermometers. One of these is doubtless the somewhat rough treatment required to re-unite the column of spirit whenever a portion becomes detached; but I do not think this cause can account for more than a very small number of the breakages. It is probable that many of these thermometers are burst by the heat of the sun, before being read and removed indoors at 10 o'clock in the morning, the hour fixed for taking the first set of observations.

Training of Observers.

18. The five observers named below have gone through a course of instruction at this office, and have obtained certificates of competency to perform the Meteorological work at second or third-class stations, as indicated. Passed Native Medical Pupil, Anaji Pandurang attended the office, at his own request, for about a fortnight, but failed to obtain a certificate of competency, for want of more time in which to qualify.

Observers trained in 1881-82.

Name.	Station.	Class.
Private Thomas Murphy	Poona	Second.
Hospital Sergeant Charles Barley	Mount Abu	Third.
Private Frederick Bateman	Karachi	Second.
Passed Native Medical Pupil, Shaik Adam	Zanzibar	Third.
Third-Class Hospital Assistant, Solomon Samuel	Rajkot	Third.

Several other new observers have been taught at the observatories by their predecessors, but there is usually, in such cases, a marked difference, for the worse, in the capability of the new, as compared with that of the old observer; and the only thoroughly satisfactory arrangement is that each observer should undergo a preliminary course of instruction in Bombay. Unfortunately this is impracticable in many cases, under existing circumstances.

Methods of Observation and Reduction.

19. No change has been made during the year in the methods of observation and reduction.

Character of the Meteorological Registers of the Year 1881.

20. In nearly all those cases in which the observers have held their appointments for a considerable time, or have had the advantage of going through a preliminary course of training at Bombay, the Meteorological registers have been carefully kept, and the observations throughout the year are accurate and trustworthy; but in the numerous instances in which it has been necessary to entrust the Meteorological work to new, untrained men, some of the more difficult observations have

usually been defective for a time. The general character of the work of the observers will be clearly seen from the following tabular statement :—

Defective Observations in the Registers of 1881.

Station.	Instrument.	Period.	Remarks.
Jacobabad	*Nil*	*Nil*	All observations good.
Bickaneer	*Nil*	*Nil*	Ditto
Hyderabad	Maximum Thermometer	May and June	Observer unable to manipulate the instrument.
Ditto	Anemometer	April, May, and June	New, untrained observer.
Ditto	Minimum Thermometer	August 13th to December 12th	Ditto.
Ditto	Wet Minimum Thermometer	Ditto	Ditto.
Karachi	*Nil*	*Nil*	All observations good.
Bhuj	Grass Thermometer	?	Instrument out of order.
Deesa	*Nil*	*Nil*	All observations good.
Mount Abu	Barometer	April 26th to 29th	Observations appear to have been taken by an untrained person.
Ditto	Ditto	October 14th to the end of the year	Observations appear untrustworthy; cause unknown.
Neemuch	*Nil*	*Nil*	All observations good.
Indore	*Nil*	*Nil*	Ditto.
Rajkot	*Nil*	*Nil*	Ditto.
Surat	Anemometer	July to October	New, untrained observer.
Akola	*Nil*	*Nil*	All observations good.
Amraoti	*Nil*	*Nil*	Ditto.
Chikalda	Grass Thermometer	?	Instrument probably out of order.
Buldana	*Nil.*	*Nil*	All observations good.
Malegaon	Wet Bulb	April 21st to May 11th	Untrained observer.
Ditto	Barometer	October 19th to 31st.	New, untrained observer.
Poona	*Nil*	*Nil*	All observations good.
Sholapur	Barometer	January	New, untrained observer.
Ratnagiri	*Nil*	*Nil*	All observations good.
Belgaum	*Nil*	*Nil*	Ditto.
Karwar	Wet Minimum Thermometer	July and part of August	Index shaken out of position by strong wind.
Ditto	Ditto	Nov. 21st to December 1st	Instrument out of order.
Zanzibar	*Nil*	*Nil*	All observations good.

Library.

21. Appendix II[1] gives the list of books and pamphlets added to the Library during the past year. Almost all are works that have been presented to the office. The books have been carefully compared with the catalogue, and none are missing.

[1] This is not reproduced.—H. F. B.

OFFICE ESTABLISHMENT.

22. From the 3rd October to the 27th December 1881, I was absent on privilege leave, and during the interval, Surgeon Major W. Nolan, M. D., officiated as Meteorological Reporter for Western India. During the year, the office establishment stood as follows :—

Name.	Monthly pay at the end of the year.
FOR LAND METEOROLOGY.	Rs.
Ganesh Sadashio	51
Vajeram Iccharam	36
Mahadeo Ramchandra	36
Krishnaji Ramchandra	30
Ramchandra Sadashio	30
FOR THE STORM-WARNING SERVICE.	
Ramchandra Govind	30
Anant Vishvamber	30
MENIAL SERVICE	
Bhicu Sitaram	10

WORK OF THE OFFICE.

23. The work of the Office has been almost entirely confined to the regular routine work of correcting and reducing the Meteorological observations recorded at twenty-two observatories, to the verification of instruments and the training of observers, to the working of the Bombay Storm-Warning Service, and to the carrying on of the correspondence which these duties entail. A sketch of the Meteorology of the Bombay Presidency, in the previous year, was, as usual, prepared, for incorporation in the General Administration Report of the Bombay Government. In this sketch I showed how the barometric observations recorded at Zanzibar confirmed the conclusions previously arrived at by me, to the effect that barometric waves of long period travel slowly from west to east. I also showed that at Bombay there is a very decided relation between the daily abnormal height of the barometer and the daily rainfall—a high barometer corresponding to a light rainfall; a low one to a heavy fall. It is obvious, from this relation, that if the daily barometric movements could be foreseen, it would be possible to forecast the corresponding variations of the daily rainfall. Hitherto the only means of judging, on any day, of the probable character of the barometric movement on the following day has been to note the particular phase of the wave-like movement going on at the time, and, from that, to infer what would follow; but I have observed that, during the monsoon, these oscillatory movements of short period are not always simultaneous at all stations, but are often slightly earlier in phase on the Coromandel Coast and in Ceylon than along the West Coast of India; and this fact affords another means of judging from the telegraphic weather reports of the character of the coming barometric changes on the West Coast, and consequently of the coming rainfall.

24. I have not been able to make much further progress during the past year with my investigations into the nature of the so-called non-periodic variations of the barometric pressure. Beyond the extension of the reductions contained in my preliminary report on "Abnormal Variations of Barometric Pressure in the Tropics, and their relation to sun-spots, rainfall, and famines," so as to obtain values of the nine-monthly means of abnormal barometric pressure, corresponding to each month, and similar data for two or three additional stations, nothing has been done. I had hoped that any spare time the two tabulators employed to work the storm-signal service might have, after performing their primary duties, would have been available for this purpose; but I have received instructions to set aside my own investigations, and employ any spare time these youths may have,

upon the preparation of a report on past storms, and upon the collection of information, and the preparation of a special report on each of the storms that may occur in the future. Under these circumstances, and as my applications for special assistance have been unsuccessful, I have no hope of being able to continue my original researches, except by employing computers at my own private expense.

25. A list of the storms of the Arabian Sea, in past years, has been prepared, giving the dates of their occurrence, the localities affected, and other details. The distribution of the storms throughout the different months of the year, from January to December, is as follows: 4, 3, 2, 9, 13, 20, 2, 2, 3, 4, 10, 2, showing that storms are more frequent from April to June and in November than at other times of the year. The frequency of storms in different years, has a decided relation to the sun-spot cycle of about eleven years, being most frequent when the spots are most numerous, and least so when the spots are at a minimum, as will be seen from the following numbers, showing the distribution of the storms in the sun-spot cycle:—

Year.	Number of Storms.	Wolf's sun-spot numbers.
1860, &c.	8	72
1861, &c.	5	57
1862, &c.	8	50
1863, &c.	5	41
1684, &c.	6	26
1865, &c.	4	11
1866, &c.	4	8
1867, &c.	7	12
1868, &c.	7	27
1869, &c.	5	53
1870, &c.	8	74

26. As a necessary preliminary to the proper study of individual storms, comparable normal values of the monthly mean pressure and temperature, at all the observatories in Western and Southern India, are being prepared. These are being calculated from the observations of the five years 1877 to 1881, and they have already brought to light many discrepancies in the barometric records. Some of the barometers appear to have gradually fallen, more especially those unfurnished with air-traps, showing the absolute necessity of the air-trap as a means of preventing the deterioration of the mercurial barometer. Another remarkable discrepancy has been found in a persistent local depression of the barometer at Masulipatam, in the winter months of 1877-78. This must either be due to some defect of the instrument, or of the method of observation, or else to a peculiar persistent local barometric anomaly, like those to which Messrs. Blanford and Eliot have drawn attention in their reports; but I do not find any reference by them to this case, although it occurred in the famine year 1877-78.

27. Registers of daily rainfall at upwards of 400 stations in the Bombay Presidency, have, as in previous years, been collected, and are carefully recorded in the Office, for future reference. The duplicate set of observations taken at the old observatories at Belgaum, Poona and Deesa, during the twelve months preceding the final closing of these observatories, have been corrected and reduced, for comparison with simultaneous observations recorded at the new observatories.

F. CHAMBERS,
Meteorological Reporter for Western India.

METEOROLOGICAL OFFICE, BOMBAY;
Dated the 2nd June 1882.

APPENDIX E. I.

Names of the Superintendents and of the Observers at the Meteorological Observatories in Western India, during the year 1881-82.

Observatory.	Class.	Officer in charge.	Date. From	Date. To	Observer.	Date. From	Date. To	Remarks.
Karachi	Second	Surgeon-Major H. M. Macbeth	1st April 1881	11th Dec. 1881	Private R. Pope	1st April 1881	3rd Dec. 1881	
		Brigade-Surgeon J. L. Hinde	12th Dec. ,,	21st Mar. 1882	Private F. Bateman	2nd Jan. 1882	31st Mar. 1882	
		Surgeon-Major J. Paxton	22nd Mar. 1882	31st ,, ,,				
Deesa	Do.	Captain F. Forgett	1st April 1881	11th May 1881	Corporal W. Birch	1st April 1881	31st ,, ,,	
		Sugeon-Major C. MacDowall	12th May ,,	4th Dec. ,,				
		Surgeon G. A. Hughes	5th Dec. ,,	5th Feb. 1882				
		Surgeon-Major C. MacDowall	6th Feb. 1882	31st Mar. ,,				
Poona (Yerrawda)	Do.	Do. J. P. Greany	1st April 1881	31st ,, ,,	Sergeant T. W. Harriott	1st ,, ,,	25th Sept. 1881	
					Private T. Murphy	26th Sept. ,,	31st Mar. 1882	
Belgaum	Do.	Do. J. F. Brodie	1st ,, ,,	22nd Oct. 1881	Lance Corporal H. Farmer[1]	1st April ,,	31st ,, ,,	
		Brigade-Surgeon T. A. Lithgow	23rd Oct. ,,	31st Mar. 1882				
Jacobabad	Third	Surgeon E. Burroughs	1st April ,,	9th July 1881	Hari Bhéu	1st ,, ,,	27th Jan. ,,	
		Do. G. E. Fooks	10th July ,,	21st Sept. ,,	Karim Raja Khan	28th Jan. 1882	31st Mar. ,,	
		Do. Masavi	22nd Sept. ,,	29th ,, ,,				
		Do. E. Burroughs	30th ,, ,,	26th Dec. ,,				
		Do. M. L. Bartholomeusz	27th Dec. ,,	31st Mar. 1882				
Bickaneer	Do.	No Superintendent	.....	.....	Ram Lal[2]	1st April 1881	16th Jan. ,,	
					No observer	17th Jan. 1882	8th Feb. ,,	
					Ram Lal	9th Feb. ,,	31st Mar. ,,	
Hyderabad (Sind)	Third	No Superintendent	1st April 1881	2nd May 1881	No observer	1st April 1881	2nd May 1881	
		Surgeon-Major J. Williamson	3rd May[2] ,,	11th Jan. 1882	Private J. Roper	3rd May ,,	12th Aug. ,,	
		Surgeon H. F. Dymmock	12th Jan. 1882	15th ,, ,,	Yousiff David	13th Aug. ,,	31st Mar. 1882	

Bhuj	Do.	Surgeon-Major C. S. Close	16th ,, ,,	31st Mar. 1882				
		Surgeon A. F. Sergent	1st April 1881	31st ,, ,,				
Mount Abu	Do.	Surgeon-Major W. Watling	1st ,, ,,	27th Nov. 1881	Narayen Máne[1]	1st April ,,	31st ,, ,,	
		Surgeon Hewett	28th Nov. ,,	27th Feb. 1882	Joseph Briggs	1st ,, ,,	15th June 1881	
		Surgeon-Major W. Watling	28th Feb. 1882	31st Mar. ,,	No observer	16th June ,,	14th Oct. ,,	
Neemuch	Do.	Assistant Apothecary A. X. Dias[3]	1st April 1881	31st ,, ,,	Hospital Sergeant C. Barley	15th Oct. ,,	31st Mar. 1882	
		Surgeon-Major R. Turner						
Indore	Do.	Do. T. Beaumont	1st ,, ,,	11th June 1881	T. Bachu[2]	1st April ,,	31st ,, ,,	
		No Superintendent	12th June ,,	19th ,, ,,	Gopal Rao	1st ,, ,,	16th Feb. ,,	
		Surgeon-Major D. F. Keegan	20th ,, ,,	31st Mar. 1882	Trimbukrao	17th Feb. 1882	31st Mar. ,,	
Rajkot	Do.	Surgeon H. P. Jervis	1st April ,,	15th Dec. 1881	Shaik Dada Mya	1st April 1881	15th Dec. 1881	
		Do. G. H. Bull	16th Dec. ,,	31st Mar. 1882	No observer	16th Dec. ,,	5th Feb. 1882	
					Solomon Samuel	6th Feb. 1882	26th ,, ,,	
					No observer	27th ,, ,,	31st Mar. 1882	
Surat	Do.	Surgeon-Major T. B. W. Johnstone	1st April ,,	19th May 1881	Dhunji bhai Motabhai[2]	1st April 1881	31st ,, ,,	
		Surgeon J. C. H. Peacocke	20th May ,,	11th June ,,				
		Do. R. Manser	12th June ,,	18th ,, ,,				
		Do. F. Jones	19th ,, ,,	31st Mar. 1882				
Akola	Do.	Apothecary D. Callaghan	1st April ,,	2nd June 1881	Samuel Gregory[2]	1st ,, ,,	31st ,, ,,	
		Surgeon T. Hume	3rd June ,,	27th Aug. ,,				
		Do. J. J. Moran	28th Aug. ,,	31st Mar. 1882				
Amraoti	Do.	Apothecary G. E. King	1st April ,,	29th Aug. 1881	Bakaram Pandurang[2]	1st ,, ,,	22nd June 1881	
		Surgeon T. Hume	30th Aug. ,,	31st Mar. 1882	Enoch Shadrach	23rd June 1881	28th ,, ,,	
					Bakaram Pandurang	29th ,, ,,	13th Feb. 1882	
Chikalda	Do.	Do. C. L. Swaine	1st April ,,	16th July 1881	Enoch Shadrach	14th Feb. 1882	31st Mar. ,,	
		Apothecary W. E. Hendricks	17th July ,,	15th Sept. ,,	Aminulla Khan	1st April 1881	31st ,, ,,	
		Surgeon C. L. Swaine	16th Sept. ,,	16th Dec. ,,				
		Apothecary W. E. Hendricks	17th Dec. ,,	19th ,, ,,				
		Surgeon C. Mallins	20th ,, ,,	31st Mar. 1882				

[1] These officers are to receive a special good service allowance of Rs. 10 per month from the 1st April 1882.
[2] Ditto ditto. Rs. 5 ditto.
[3] Alternately in periods of fifteen days to about a month each.

Names of the Superintendents and of the Observers at the Meteorological Observatories in Western India during the year 1881-82,—concld.

Observatory.	Class.	Officer in charge.	Date. From	Date. To	Observer.	Date. From	Date. To	Remarks.
Buldana	Third	Surgeon A. R. Menasse	1st April 1881	30th June 1881	Pandurang Krishnaji	1st April 1881	31st Mar. 1882	
		Do. D. Callaghan	1st July ,,	30th Sept. ,,				
		Do. A. R. Menasse	1st Oct. ,,	18th Nov. ,,				
		Do. D. Callaghan	19th Nov. ,,	31st Mar. 1882				
Malegaon	Do.	No Superintendent	1st April ,,	24th April 1881	Goolab Khan	1st ,, ,,	27th May 1881	
		Surgeon A. W. F. Street	25th ,, ,,	9th Nov. ,,	Keshav Govind	28th May ,,	5th June ,,	
		Brigade-Surgeon W. E. Cotes	10th Nov. ,,	17th Feb. 1882	Gopal Cuddum	6th June ,,	9th Nov. ,,	
		Surgeon W. A. Corkery	18th Feb. 1882	31st Mar. ,,	Anaji Pandurang	10th Nov. ,,	9th Jan. 1882	
					Gopal Cuddum	10th Jan. 1882	31st Mar. ,,	
Sholapur	Do.	Do. H. B. Briggs	1st April 1881	31st ,, ,,	Davidin	1st April 1881	4th May 1881	
					Shamji Gharoji	5th May ,,	8th June ,,	
					Keshav Govind	9th June ,,	31st Mar. 1882	
Ratnagiri	Do.	Do. H. McCalman	1st ,, ,,	16th ,, ,,	Mahadev Cuddum[1]	1st April ,,	31st ,, ,,	
		Surgeon-Major M. M. Mackenzie	17th Mar. 1882	31st ,, ,,				
Karwar	Voluntary	R. G. C. Westbrook, Esq., Port Officer	1st April 1881	31st ,, ,,	G. W. M. D'Aranjo	1st ,, ,,	31st Jan. ,,	
					Damodher Vishnu	1st Feb. 1882	31st Mar. ,,	
Zanzibar	Do.	Surgeon-Major C. Peters	1st ,, ,,	6th April 1881	Surgeon-Major C. Peters	1st April 1881	6th April ,,	
		Do. John Robbs	7th ,, ,,	31st Mar. 1882	Do. John Robbs	7th ,, ,,	31st Dec. ,,	
					Shaik Adam	1st Jan. ,,	31st Mar. 1882	
Calicut	Storm Warning Service.	Henry Richardson, Esq., Port Officer	1st ,, ,,	31st ,, ,,	F D. Rozario	1st April ,,	31st ,, ,,	

[1] These officers are to receive a special good service allowance of Rs. 5 per month from the 1st April 1882.

APPENDIX F.

Administration Report of the Meteorological Reporter to the Government of Madras for the year 1881-82.

The Meteorological Department of the Madras Presidency, hitherto under the charge of the Government Astronomer, was separated from the Astronomical Department in July 1881. The establishment under the present Meteorological Superintendent comprises eleven old stations, at which observations have been recorded three times daily, *viz.*, at 10 A.M., 4 P.M., and 10 P.M.; and three new ones. The Madras Register is still kept at the Government Observatory, but is available to the Meteorological Reporter, thereby saving a separate record, otherwise requisite. The following is a complete list of the observatories which furnish returns in this Presidency:—

Madras.	Madura.	Trichinopoly.
Bangalore.	Masulipatam.	Wellington.
Bellary.	Negapatam.	Amini Divi.
Cochin.	Salem.	Mangalore.
Coimbatore.	Secunderabad.	Mercara.

MADRAS.

The observations at Madras were commenced in 1792, and have been continued with only one break, from 1807 to 1811, up to the present time. Hourly observations were taken continuously from March 1841 to April 1861, furnishing hourly corrections, strictly applicable to all places on the Eastern side of the Presidency, and rendering Madras, for all future time, a first-class station, at whatever hours observations may be recorded. For the West Coast stations, the hourly corrections deduced at Bombay would probably be more suitable.

All the barometers, dry and wet bulb thermometers, and anemometers, used while the Government Astronomer held charge, were compared with the Madras standards before being issued. The standard barometer No. 49, Newman, has a tube 0·514 inch in diameter, and is one of two sent out by the Royal Society in 1839. It was returned to England, to be thoroughly cleaned and repaired, in 1875, and, agreeably to subsequent comparisons with two excellent barometers from Calcutta, it does not appear to have undergone any change since its first arrival in India. The instrument is hung in a room, on the ground floor, in the Madras Observatory Office building; its cistern being twenty-two feet above sea-level.

The standard reference thermometer is one furnished from the Kew Observatory by Professor Balfour Stewart in 1861.

The dry and wet bulb thermometers in use since January 1st, 1868, are No. 2308, Negretti and Zambra. All the minimum thermometers are compared at 10 P.M., and the mean of the resulting corrections adopted for each month. The sun thermometer, *in vacuo*, is also compared at 10 P.M., as its readings are evidently affected by day-light and shew discordances, when compared by day-light, which do not exist amongst the night comparisons. The dry maximum thermometer is compared daily at 10 A.M. Records of a freely-exposed sun thermometer were formally kept, as well as of ozone; but both have been discontinued for some years past.

Prior to the establishment of the Madras Presidency Meteorological Department by my father, the Government Astronomer, in 1868, the thermometers at the Madras Observatory were recorded in a verandah facing the north; but as he did not consider them sufficiently exposed, fresh instruments were taken into use from the 1st of January, hung in a well-thatched shed about 50 yards from the verandah. The observations were continued in both places simultaneously for five years, to ascertain what difference the change of position made. It was found that while the mean temperatures in the shed and verandah were almost identical, the range was nearly half as much again in the shed as in the verandah.

A plan of the sheds, shewing the arrangement of the thermometers and other instruments, at Madras and at all the observatories started by my father, is given as a frontispiece. [1] The dimensions of the shed and of the thermometer-board are marked on the plan. Its roof consists of bamboo-matting, with a substantial thatching of straw, 6 inches thick, over it, to prevent the thermometers from being affected by sun or rain. At a few stations, where straw is difficult to obtain, the cadjan or palm-leaves, have been used instead, but straw is decidedly preferable. The side-screens are similarly constructed, but not quite so thick, and leaving a clear space of about 9 inches from the ground, to admit the free passage of the air, and yet to shield the thermometers from either direct or reflected sunshine. The small letters shewing the places of each thermometer on the stand need no explanation. The framework of each shed was made at the Madras Public Works workshops, and forwarded by the Government Astronomer to each up-country station, with a plan, and general instructions as to its erection and the placing of the thermometers.

The anemograph was constructed by the late Mr. Adie of London and Edinburgh, and after being highly commended at the Paris Exhibition in 1862, was forwarded to Madras, and taken into use in 1864. It is erected on the roof of the Government Astronomer's house, about 50 feet above the ground; the registration of wind velocity, direction, and rainfall being made by machinery, in a small room below. The standard rain-gauge is, of course, on the ground, as shewn in the plan of the shed; but the record, furnished by the anemograph gauge, enables the quantity collected on the ground to be proportionally divided, so as to shew at what time, and under what wind direction, it fell.

Notices of bad weather are given to the Marine Department, by the Government Astronomer, whenever considered necessary.

Code weather-messages for Bombay and Calcutta, as well as to Simla during the official season, are wired down to the Government Telegraph Office immediately after noon every day.

Bangalore.

The register at this observatory was commenced in November 1867, and has been continued, without any serious breaks, up to the present time.

The barometer is in a room in the Bowring Hospital, facing south, and the thermometer-shed is erected on an open space, a considerable distance from any walls or buildings. The anemometer and wind-vane are placed on the top of the Market Serjeant's house, in the vicinity of the Hospital; the cups of the former being 30 feet above the surrounding ground and about 6 feet above the roof of the house.

The Assistant, O. Rungasawmy Moodaliar, is a careful, trustworthy observer, and having served twenty-three months at the Madras observatory before taking up his appointment, he reduces his observations accurately, and furnishes the records and registers punctually. Bangalore is one of the best-conducted Meteorological observatories in the Presidency, due, no doubt, in a great measure, to the able supervision of the successive Medical Officers in charge. This station was inspected by Mr. J. Eliot, while Officiating Meteorological Reporter to the Government of India, who reported as follows:—

"Inspected the Bangalore observatory, 13th January 1882. The barometer is well placed and in good order. The shed is in a very fair condition, and the instruments properly placed and in good order, except the wet-bulb, which was covered with a slight incrustation. The wind-vane and anemometer are both very dirty, and ought to be carefully cleaned, and, if necessary, the anemometer sent to Madras, after another has been procured. The remaining instruments are in good order. The observer does his work carefully, accurately, and neatly. The only suggestion I have to make is, that he should pay somewhat more attention to the cleanliness of his instruments."

Bellary.

Records at this station were commenced in December 1867 and have been carried on in a satisactory way ever since.

[1] Not received with the report.—H. F. B.

The barometer is placed in a small room adjoining the Civil Dispensary. The anemometer and wind-vane are fixed on a stand on the roof of the Civil Dispensary, 26 feet from the ground. Throughout the year 1881, the observations went on steadily, with the exception of two breaks in the records of the dry and wet minimum thermometers, the former from February 9th to September 2nd, and the latter from November 1st to December 20th. These instruments could not be replaced, as the reserve supply at Madras was exhausted. In accordance with Mr. Blanford's wishes hourly observations, on four days in each month, were started on the 21st of December. Synoptic, observations, taken daily, at the local time, corresponding to 7 A M. Washington time, for the United States International Weather Bulletin, were also commenced from the same date. To prevent any misunderstanding in connection with the new duties required of the assistant, Dr. Archdall desired him to proceed to Madras, to receive further instructions; and as the mercury in the cistern of the barometer then in use was reported oxidised and in need of being cleaned, I thought this a favourable opportunity for changing it. A fresh instrument, duly compared with the Madras observatory standard, was accordingly sent in charge of the assistant, who took it into use at 10 A.M. on the 24th of December.

Bellary may be regarded as one of the fortunate stations, at which the Medical Officer in charge takes an interest in the work and signs the records and reductions before despatching them to me. Wherever this is the case, the observer is encouraged, and the result is more accurate, neater, and better work. The first assistant B. Sashachellum, is a careful, trustworthy man, and since his visit to the Madras Office, he has carried his duties on in a praiseworthy manner, reducing all his observations correctly, and enabling them to reach me in good time. From January to March the reductions were only partially done by him; from April to June by the Madras observatory assistants, and, since, by Sashachellum. A second assistant, on a salary of Rs. 10, has been employed at this station to help the first in taking the hourly observations, since December.

COCHIN.

This station was started in February 1868, and although the same amount of care was taken in supplying properly compared instruments and instructing an assistant, the work was for some time in a most unsatisfactory state. Being considered an unhealthy place for natives, there has always been some difficulty in getting an assistant willing to undertake the duties there, in consequence of which Eurasians have been employed on several occasions, and the result has too frequently been a complete failure. Since the appointment of the present assistant, Narayanasawmy, the records have been quite trustworthy, but ill-health has of late, caused him to make repeated applications to be transferred to another station.

The barometer is placed in a small room facing westward. The thermometer-shed is in the Hospital compound, and there are extensive cocoanut plantations at some distance to the east and south, with a backwater 300 yards distant. The anemometer is fixed on a wooden column, about 2 feet above the roof of the shed and is secured to its northern pole. Throughout the year 1881 the work at this station has been very good indeed.

The assistant has reduced his observations regularly and correctly, and they have been forwarded to me generally within a week after date. The instruments were in fair condition, with the exception of the sum maximum thermometer, which got out of order several times, and the anemometer, the readings of which were worthless, owing to one of the cups having been broken off and soldered on in the bazaar.

COIMBATORE.

The records from this station date from the 15th of November 1867, and, throughout the time, the work has been excellent.

The barometer is placed in a room at the east end of the Hospital, facing north. The anemometer is fixed on the southern end of the thermometer-shed, at a height of 14 feet from the ground, and the shed is erected at a distance of about 36 feet east of the Hospital. The work at this observatory during the year 1881, has been quite satisfactory.

The Assistant is a careful, trustworthy man, and having been employed in the Madras observatory from January 1852 to July 1877, when he was transferred to Coimbatore, he is well practised at his work and reduces his observations without any difficulty. The records and reductions generally reach this Office within a week or ten days after the end of each month.

MADURA.

The observations at this station commenced on the 6th of February 1868.

The barometer is kept in the consulting room of the Dispensary, about 22 feet above the ground. The thermometer-shed is placed in the centre of a large square, bounded on the west by a cocoanut tope, on the north by a public road and an avenue of trees, and open for some considerable distance on the other two sides. The anemometer is on the roof of one of the Dispensary buildings and is 31 feet above the level of the ground; but there are several trees in the neighbourhood, which must influence the readings, though, as no better site could be found, this is unavoidable. The records during 1881, were incomplete, owing to the breakage of the wet minimum thermometer. The comparisons of the grass minimum were also incorrect, due, most probably, to the instrument having been placed on its stand at 4 P.M., instead of leaving it in the shed till 10 P.M., and comparing it before exposing it for the night.

The Assistant was taught to record and reduce his observations at the Madras observatory, and he can do the work when he pleases; but throughout 1881, no attempt was made at the latter, and consequently all reductions had to be made in the Madras Office. This station was inspected by Mr. J. Eliot, while Officiating Meteorological Reporter to the Government of India, when he reported as follows:—

"Inspected the observatory on the 15th of January 1882. The shed and instruments are generally in good condition and properly placed. The only suggestions I have to make are the following:—

1st.—That the small compound in which the shed is placed should be cleaned out; the trees and shrubs, more especially those in the west corner, being removed, so that the exposure of the instruments may be as perfect as possible.

2nd.—That the barometer should be returned to Madras, in exchange for another, in which the mercury is cleaner, at an early opportunity.

3rd.—That the anemometer should be rigidly fixed to its support.

I am quite satisfied with the condition of the observatory. The observer, I may add, takes the observations accurately and his records appear to be in good order."

MASULIPATAM.

The Government Astronomer superintended the erection of the thermometer-shed and instruments, instructed the assistant and started the observations in August 1868, during the Total Solar Eclipse Expedition of that year, and the work has been carried on in a fairly satisfactory way ever since.

The barometer is fixed on a wall, facing the east, in the Meteorological Office room, in the Civil Dispensary, and is so placed that neither currents of wind can blow, nor too much light can fall on it to vitiate its readings in any degree. The thermometer board in the shed faces due north, and the instruments are in a line with the centre of the two side-screens. The sun-thermometer and the rain-gauge are placed out of the shed, within the posts and tarred ropes, just as pointed out in the lithographed plan of thermometer-shed, shewing the general arrangement of all the instruments. Throughout 1881, the observations have been carried on steadily, but no anemometer has yet been put up, owing to difficulties in getting a staging erected for the instrument.

I believe the assistant does his best in recording the observations, but he has never reduced any: he appears anxious to learn, but will not come to Madras to be instructed, although strongly advised to do so, both by Mr. Eliot and myself. It is rarely possible to teach an assistant to reduce his obser-

vations, according to the plan adopted at Madras, by letter. The records from this station were pretty punctually submitted to me for reduction, and the staging for the anemometer is now ready, thanks to the interest taken in the observatory by Dr. W. H. Thornhill, who had charge of the station during the year."

NEGAPATAM.

Observations at this station were commenced on June 1st, 1868, by an observatory assistant, who was transferred, and having been well accustomed to recording hourly observations for many years at Madras, was well up to his work, and carried it on creditably until he retired. In November 1871 the thermometer-shed was blown away during a storm, which caused a break of some months in the records.

The barometer is placed in a room in the south-eastern part of the Hospital, 13 feet long, 8 broad, and 15 high, with a large window facing the sea. A pandal, which extends over the window, prevents rain or sun from entering the room. The shed in which the thermometers are placed is situated within the compound of the Hospital, on the northern side, and opposite to the Office of the Doctor in charge, and a few yards from the main road. The shed is strongly thatched. The stand of the thermometers is fixed facing the north. The fork for the sun and grass thermometers is farther south, and the rain-gauge stand is raised about 18 inches above the surrounding ground. All these are defended by rails, to keep out cattle; and the entrance at the south end is guarded by a stile. The anemometer and wind-vane are placed near each other, 30 feet above the level of the surrounding ground, on the north-western part of the upper story of the Hospital building. The records, during 1881, were not very satisfactory, some of the wet minimum thermometer readings having to be rejected, and several of the records of the grass minimum being questionable.

The assistant was taught to record and reduce his observations before being appointed, and can do his work well; but having taken the observations, he is dilatory in regard to their reductions, and so, up to October, these had to be done at the Madras Office. Since then, however, I am glad to remark, he has improved, and the records and reductions have been forwarded in better time. Mr. J. Eliot, while Officiating Meteorological Reporter to the Government of India, visited this station, and made the following favourable report of the state in which he found everything:—

"Inspected the Negapatam observatory, 16th January 1882. The shed is well placed, open in all directions and in good order. The various instruments are all clean and in perfectly good order. The observer takes the observations accurately and intelligently. The condition of the observatory is very satisfactory and creditable to the observer. In future, hourly or bi-hourly telegraphic weather-reports will occasionally be asked for by telegram from Calcutta during stormy weather. These telegrams should be continued until the receipt of a telegram from Calcutta that they may be discontinued."

SALEM.

This station was started on the 1st of November 1867, and has been one of the most satisfactory in the Presidency. As at Negapatam, a good trustworthy assistant, who had served for many years in the Madras observatory, and participated in recording and reducing the hourly observations, was transferred to Salem, where he remained until pensioned in November 1874.

The barometer is kept in a small room, about 10 feet square, forming the north-east angle of the In-patient Department of the Civil Dispensary, facing north, with a window opposite and a door on the eastern side. The thermometer-shed is in the Cutcherry compound, so placed on account of its being under the protection of the Treasury Guard, and is built strictly in accordance with standing orders, 96 feet from the Cutcherry buildings and 74 feet from the enclosing wall of the compound. The anemometer and wind-vane are placed over the flat roof of the Cutcherry, at its south-west angle, the position being such that adjoining buildings and trees shall least impede the free access of wind. The cups are 32 feet above the ground. The records throughout 1881 have been satisfactory.

The assistant works neatly and accurately, but he is dilatory about submitting his records, and though he understands reducing the observations, he never attempted anything of the kind throughout the year.

SECUNDERABAD.

The records at this station were commenced on the 1st of November 1867; but the results have never been satisfactory, owing to the inefficiency of the assistant, who was appointed upon the strong recommendation of the Secretary to the Sanitary Commissioner, who was formerly the Medical Officer in charge, without having had any previous training at the Madras observatory. The records were made throughout 1881, but little reliance can be placed on them. The Secunderabad station was visited by Mr. J. Eliot during his tour in this Presidency, while Officiating Meteorological Reporter to the Government of India, when he reported as follows:—

"Inspected the Secunderabad observatory, 21st January 1882. The instruments were generally very dirty. The wet bulbs were covered with a thick incrustation, and the remaining thermometers were more or less coated with dust. The grass radiation thermometer, although in use, was quite out of order, three separate portions being detached from the main column. The vertical support of the wind-vane is several degrees out of the vertical. The anemometer is quite loosely attached to its wooden base. There is no receptacle for the rain-fall in the rain-gauge. Altogether, the condition of the observatory was most unsatisfactory. The observer is quite unable to read the anemometer, and the previous wind-returns are worthless. He does not reduce his observations like other observers in the Madras Presidency, although he receives the full forty rupees per mensem. I am also quite convinced in my own mind that he has not taken the observations accurately at the hours laid down by the Madras Reporter. Under these circumstances, it appears to me that the previous Meteorological Observations of this observatory are of little or no value, and that it is therefore, necessary to place it on a different footing, in order that Government may have faithful, honest, and accurate work done in return for the money expended. The present observer will therefore, be very shortly relieved by a competent observer, who will be sent from Madras; but until his arrival, he will take the observations as hitherto. He may apply for pension, but its grant will depend mainly upon the opinion of the previous and present Meteorological Reporters, as to whether he deserves it, and also upon the manner in which he does his work up to the arrival of the new observer and in which he makes over charge of the observatory."

In accordance with the above, a new assistant was instructed at the Madras observatory, both to record and reduce the observations, and was sent to Secunderabad in charge of a fresh barometer and several other instruments. Since the appointment of Mr. Williams on the 27th of February, I am pleased to state that there has been a thorough change in the work, which I hope will continue. The reductions are now made at Secunderabad, and forwarded to me, together with the records, within a week or ten days after the end of each month.

TRICHINOPOLY.

Observations at this station commenced on the 1st of December 1867. The barometer hangs on the south wall of a small room, facing east, and the cistern is about 18 inches from the ground. The thermometer-shed is well adapted for its purpose, being in an open space, well exposed, and with a well-thatched roof. The sun thermometer is about a foot from the ground. The rain-gauge is well placed, and the anemometer and wind-vane are freely exposed to every current of air. The anemometer cups are 24 feet above the ground, and the wind-vane is about 2 feet higher. The records at this observatory throughout the year 1881 were very good, no breaks having occurred. As at Bellary, hourly observations, on four days in each month, were started from the 7th of December, and a series of Synoptic observations were taken at the local time, corresponding to 7 A.M. Washington Mean Time, for the United States "International Weather Bulletin." It is, therefore, necessary that the records and results should be forwarded to the Madras Office with as little delay as possible; but I regret to state that it is only after repeated enquiries, threats of suspension and fines, that the assistant at Trichinopoly sends me his records; and though he was taught at Madras to reduce his

observations, he did not do any in 1881, and has only commenced lately, still neglecting the reduction of the hourly observations. On the whole, I consider Lutchman Row exceedingly negligent, and unless he improves, I would strongly advise his pay being diminished, to enable me to employ another assistant at my Office to finish his work. I believe him to be a capable observer, if better disposed; but he lacks energy.

WELLINGTON.

This station was started in March 1870, and for some years the work went on very creditably, in charge of Serjeant J. Coghlan, who was duly trained for his duties at Madras. Between 1877 and 1880 several changes took place, and as the Hospital Serjeant was at that time always the observer, whether qualified or not, the records deteriorated, until they became utterly worthless. The appointment of pensioned Serjeant H. Brownsell as permanent assistant in August 1880, restored the observatory to its former efficiency, as he had not only received proper instructions at Madras in 1874, but had subsequently filled the post of observer at Bellary most satisfactorily, until his retirement on pension in 1878.

The barometer is fixed against the wall of a room belonging to the Hospital. The thermometer-shed is situated on the Hospital plateau, and was carefully placed due north and south. There was some difficulty in finding a suitable site for the anemometer, in consequence of which this instrument has not yet been brought into use; but the erection of the staging is in progress and it will soon be ready for the instrument. With the exception of the sun maximum thermometer, the records were complete, and the instruments in good order throughout 1881.

The assistant partially reduced his observations, till September, since then they have been done at Madras; but as soon as the new forms are obtained, I hope he will do the reductions completely. The records are forwarded to me generally within a week after date.

AMINI DIVI.

Barometric records were started three times daily, at 10 A.M., 4 P.M., and 10 P.M., in September 1880, and registers of the thermometers have been kept since July 1st, 1881, and of the anemometer since December 1st.

The observer, Syed Abdool Rahman, Second Class Hospital Assistant, attached to the Laccadive Islands, was instructed both to record and reduce his observations at the Madras observatory, when he appeared intelligent and anxious to undertake the duties.

A barometer, duly compared with the Madras Standard, was sent in charge of the assistant, and a complete supply of thermometers and other necessary instruments were supplied from Calcutta. The records from this station are forwarded when possible; but owing to there being no Post, and, for several months in the year, no communication with the islands, they cannot reach my Office at regular times. They have, however, been received up to December last, and are now being reduced at Madras. As it is a third-class station, the observer is only required to record observations twice daily; but they have been taken so far thrice daily, as at other stations in the Presidency. It is to be regretted that, as the Hospital Assistant has to go on circuit for several weeks together, there must be frequent breaks in the registers, rendering the work incomplete. He was away on privilege leave for three months, and as no substitute could be found to carry on his duties, another break would be thereby inevitable. Unless a man can be specially appointed to take charge of the Meteorology at this station, it seems almost useless to continue it. I would suggest that special arrangements might be made, to enable the work to be kept up regularly in future.

MANGALORE.

This being a third-class station, observations are recorded only twice daily, *viz.*, at 10 A.M. and 4 P.M. It is under the care of the Telegraph Master, who reads the instruments himself and forwards the records to the Madras Office every week. This station was transferred to me by the Meteorological Reporter to the Government of India on the 1st of January 1881. The records await

reduction. As the instruments in use at this observatory were supplied from Calcutta, any further remarks are unnecessary.

MERCARA.

Like the above, this is a third-class observatory, recording observations at 10 A.M. and 4 P.M only, and the duty is carried on by the Telegraph Master, who despatches his records to my Office regularly every week. The registers will be reduced as soon as time permits. This station was also transferred to me from the 1st of January 1882. All the instruments were supplied from the Head Office at Calcutta.

From the foregoing brief descriptions, it will be seen that, with the exception of one station, the work has been very satisfactory throughout the year, for which special thanks are due to the Medical Officers in charge, for their able supervision and general interest in the work. Breakages of instruments are at once reported to this Office, enabling me to replace them without serious interruptions in the returns. As will be seen from one of the Tables, several new instruments were immediately despatched to various stations, on the receipt of a supply from Calcutta.

All the barometers and anemometers have been carefully compared with the standards at the Madras observatory, since the Department started in 1867—in most cases by the Government Astronomer himself.

The Madras Meteorological Office Establishment, on the 31st of December, consisted of but one assistant, who was sanctioned by the Madras Government in 1877; previous to which time, all the reductions were done by the observatory assistants, four of whom have been constantly employed in the same work until lately. On applying to Mr. Blanford for a copying clerk and a peon, these were granted in March; the former on a salary of Rs. 20, and the latter on Rs. 8 per mensem. The time has now arrived when the Government Astronomer will have to publish his Astronomical Works, and he can no longer spare his assistants for other duties than those of the observatory It is therefore absolutely necessary that at least two, if not three, extra assistants should be employed at Madras, to keep the work regularly up to date, and to enable me to supply copies of all the results to the Meteorological Reporter to the Government of India soon after the end of each month, as I intended on taking charge. Although most of the assistants up-country now reduce their observations, it is necessary to have all the registers revised at my Office, and such revision takes nearly all the time of the most trustworthy assistant at Madras. The second assistant finds occupation enough in making the required number of copies, consequently some part of the work must fall back. The introduction of Tension of Vapour caused new Forms, with the necessary additional columns to be required, and the slow progress of printing has prevented the despatch of returns so far, since December last. Few of the assistants have yet acquired dexterity in the use of the Tension Tables, and in all cases the numbers require checking at Madras, while in nearly all, the whole of the work had to be done in my Office.

Rain Reports are forwarded from numerous Revenue Board Stations to the Government Astronomer, and it is probable that these will shortly be handed over to the care of the Meteorological Superintendent. New and carefully-tested rain-gauges and glasses were supplied to 226 of the rain stations by the Government Astronomer, and it is only from such places that the returns are accepted, and the results tabulated in the Meteorological Supplement to the *Fort St. George Gazette*. The gauges were made at the Madras Public Works workshops, and were all tested as to size of funnel and contents of glass-measure at the observatory, so that the uncertainty should be within 0.005 per inch of rainfall.

ELIZABETH ISIS POGSON,
Meteorological Reporter, Government of Madras.

METEOROLOGICAL OFFICE, MADRAS;
The 15th July 1882.

APPENDIX F. I.

Complete List of Officers in Charge and Assistants in the Madras Presidency Meteorological Department in the official year 1881-82.

STATION.	Officer in Charge.	From	To	Assistant.	From	To
Madras	N. R. Pogson, Esq., C.I.E., Government Astronomer	1st April 1867	24th July 1881	J. Vythinatha Iyer, First	1st February 1878	31st March 1882
	Miss E. Isis Pogson, Meteorological Reporter	25th July 1881	31st March 1882	N. E. Kangayam Pillay, Second	1st March 1882	31st March ,,
Amini Divi	Syed Abdool Rahaman	.....	31st March ,,	None	...	...
Bangalore	Surgeon P. H. Benson, M.B.	1st April ,,	31st March ,,	Rungasawmy Moodaliar	1st September 1871	31st March ,,
Bellary	Surgeon-Major F. M. G. Archdall	11th February ,,	31st March ,,	B. G. Sashachellum, First	31st August 1878	31st March ,,
				Sreenevasa Row, Second	21st December 1881	31st March ,,
Cochin	Surgeon-Major W. H. Morgan	30th April 1878	7th March ,,	G. Narayanasawmy	7th November 1880	31st March ,,
	Surgeon A. J. O'Hara	8th March 1882	31st March ,,	.....	...	..
Coimbatore	Surgeon-Major G. E. Whitton, M.B. & B.A.	9th January 1880	6th March ,,	Varadiah Naidu	1st July 1877	31st March ,,
	Surgeon G. M. E. McKee	7th March 1882	31st March ,,	.....	...	...
Madura	Surgeon J. Lancaster, M.B.	18th June 1880	31st March ,,	V. Sashachellum	19th November 1867	31st March ,,
Mangalore	Telegraph Master	.....	31st March ,,	None	...	...
Masulipatam	Surgeon W. H. Thornhill, M.D., M.C. & B.A.	18th March 1881	2nd March ,,	Uma Ranganayakulu Naidu	1st August 1868	31st March ,,
	Surgeon F. J. Doyle	3rd March 1882	31st March ,,	.....	...	
Mercara	Telegraph Master, H. Duckworth	.....	31st March ,,	None	...	..
Negapatam	E. A. Morris, Esq., L.R.C.P. & L.R.C.S.E.	15th November 1880	31st March ,,	S. Saminatha Iyer	5th September 1874	31st March ,,
Salem	Surgeon-Major H. J. Haylett	2nd November ,,	31st March ,,	L. Ramsing	13th October 1880	31st March ,,
Secunderabad	Surgeon J. J. Moran, M.D.	29th December ,,	17th August 1881	V. Coopoosawmy	1st November 1867	20th February ,,
	Surgeon A. P. Adams	18th August 1881	6th November ,,	J. T. Williams	27th February 1882	31st March ,,
	Surgeon E. M. Damla	7th November ,,	31st March 1882	.....	...	...
Trichinopoly	Surgeon-Major J. B. Thomas, L.R.C.P.L.	3rd December 1879	31st March ,,	T. Lutchman Row, First	21st November 1874	31st March ,,
				E. M. Bhojarajoloo, Naidu, Second	1st December 1881	31st March ,,
Wellington	Surgeon-Major R. Waters, M.D.	1st April 1881	8th February 1882	Sergeant H. Brounsell	1st August 1880	31st March ,,
	Surgeon-Major J. Fleming, M.D.	9th February 1882	31st March ,,	.....	...	

APPENDIX G.

Statement showing the names of Superintendents and Observers of the Observatories in British Burma for the official year 1881-82.

Stations.	Names.	Appointments.	Remarks.
Rangoon	Surgeon-Major H. Johnstone	Superintendent	Joined 22nd May 1878. On furlough to Europe from 24th March 1882.
	Ditto D. Sinclair	Ditto	Joined 24th March 1882.
	A. E. Sarfas	Observer	.....
	Moung Yam Hmoo	Assistant Observer	„ 15th March 1881, left on 1st March 1882.
	A. V. Peramal	Ditto	„ 1st May 1881.
Moulmein	Surgeon-Major W. F. deFabeck, M.D., M.R.C.S.L.	Superintendent	Throughout the year.
	Hospital Assistant F. Hilbert	Observer	
Bassein	Dr. Oswald Baker, Surgeon, Indian Medical Department, Civil Surgeon, Bassein	Superintendent	From 1st April to 31st October 1881.
	Dr. S. H. Dantra, Surgeon, Indian Medical Department, Civil Surgeon, Bassein	Ditto	„ 1st November 1881 to 31st March 1882.
	Ah Guway Soon	Observer	Throughout the year.
Thyetmin	B. N. Chowdry, Asst. Surg.	Superintendent	From 1st April to 3rd May 1881.
	Alla Deen, 2nd Class Hospital Assistant	Ditto	„ 4th May to 7th May 1881.
	E. P. Frenchman, Surgeon, I.M.D.	Ditto	„ 7th May to 13th June 1881.
	P. W. Dalzell, ditto	Ditto	„ 13th June to 13th December 1881.
	Alla Deen, 2nd Class, Hospital Assistant	Ditto	„ 14th December to 29th December 1881.
	P. W. Dalzell, Surgeon, I.M.D.	Ditto	„ 29th December 1881 to 31st March 1882.
	Alla Deen, 2nd Class Hospital Asst.	Observer	Throughout the year.
Mergui	Asst. Surg. Devendranath Roy	Superintendent	From 1st to 8th April 1881.
	Ditto Kally Dass Bose	Ditto	„ 9th April to 2nd May 1881.
	Hospital Assistant Rajub Ally	Ditto	„ 3rd May to 6th August 1881.
	Assistant Surgeon Omerto Lal Moonshee	Ditto	„ 7th August 1881 to 31st March 1882.
	Mahomed Cassim	Observer	„ 1st April 1881 to 31st March 1882.
Tounghoo	Surgeon H. Pemberton	Superintendent	From 1st April to 28th April 1881.
	Ditto C. Rundle	Ditto	„ 29th April 1881 to 16th February 1882.
	Ditto H. Pemberton	Ditto	„ 17th February to 31st March 1882.
	3rd Class, Hospital Assistant, V. Chinasawmy Pillai	Observer	„ 1st April 1881 to 31st October 1881.
	2nd Class, Hospital Assistant, V. Venkatasawmy Naidu	Ditto	„ 1st November 1881 to 16th February 1882.
	3rd Class, Hospital Assistant, V. Chinasawmy Pillai	Ditto	„ 17th February to 31st March 1882.

RANGOON;
The 22nd May 1882.

A. W. KELLY,
Sanitary Commissioner, British Burma.

APPENDIX H.

Return of the Names of the Superintendents and Observers at the Port Blair and Nancowry Observatories during the year 1881-82.

Port Blair.			Nancowry.		
Names.	From	To	Names.	From	To
Superintendents.			*Superintendents.*		
Surgeon W. Beatson .	1st April 1881	28th Dec. 1881	*None.*		
,, J. Reid, M.B .	29th Dec. 1881	31st March 1882	.....		
Observers.			*Observers.*		
J. T. Peters . . .	1st April 1881	31st March 1882	D. Guanayathum .	1st April 1881	20th May 1881
			V. Nummiah . .	21st May 1881	11th Aug. 1881
			C. Soobroyaloo Naidu.	12th Aug. 1881	28th Jan. 1882
			S. Thomas . . .	29th Jan. 1882	31st March 1882

PORT BLAIR,
The 1st April 1882.

JAMES REID, M. B., *Surgeon,*
Senior Medical Officer,
Port Blair, Nicobars.

APPENDIX I.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Director of the Meteorological Observatory.
Agra	The Editor of the *Delhi Gazette*.
Ajmere	Secretary to the Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Le Général Commandant Superieur du Genie en Algerie.
Allahabad	Secretary to the Government, North-Western Provinces and Oudh.
	Director, Department of Revenue and Agriculture, North-Western Provinces an Oudh.
	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
	Editor of the *Pioneer*.
Amsterdam	Secretary to the Royal Academy of Sciences.
Bangalore	Secretary to the Chief Commissioner, Mysore and Coorg.
	Conservator of Forests, Mysore and Coorg.
Batavia, Java	Director of the Meteorological Observatory.
Berlin	Ditto ditto Institute.
Bombay	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Superintendent of the Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
	Registrar of the Bombay University.
	Secretary to the Asiatic Society of Bombay.
	Superintendent of the Bombay Sassoon Mechanics' Institute.
	Secretary to the Geographical Society of Bombay.
	Editor of the *Bombay Gazette*.
	Ditto *Times of India*.
Brisbane Queensland . . .	Principal of the Elphinstone College.
Brussels	Superintendent of the Observatory.
	Secretary to the Royal Academy of Sciences.
Budapesth	Director of the Observatoire Royal.
Buenos Aires	Ditto Observatory.
	Ditto Meteorological Office.
Calcutta	Secretary of State for India (through Revenue and Agricultural Department).
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto, Home Department.

List of Recipients of the Publications of the Meteorological Office—continued.

Calcutta	Secretary to the Government of India, Public Works Department.
	Ditto ditto, Foreign Department.
	Ditto ditto, Department of Finance and Commerce
	Ditto ditto, Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor General of India.
	Superintendent, Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanic Gardens, Calcutta.
	Inspector General of Forests, with the Government of India.
	Secretary to the Surgeon-General, ditto ditto.
	Ditto Asiatic Society, Bengal.
	Librarian, Indian Museum Library.
	Registrar of the Calcutta University.
	Principal of the Presidency College.
	Librarian, Public Library.
	Editor of the *Calcutta Review*.
	Ditto *Statesman and Friend of India*.
	Ditto *Englishman*.
	Ditto *Indian Daily News*.
	Ditto *Hindoo Patriot*.
	Ditto *Indian Agriculturist*.
Cambridge	Reverend E. Lafont, S.J.
	Librarian of the University Library.
Cambridge, Massachusetts	Ditto Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Germany	Director of the Baden Meteorological Observatory.
Chemnitz	Director of the Royal Meteorological Institute.
Chatham	Librarian, Royal Engineers' Library.
Christiania	Director of the Norske Meteorologiske Institut.
	Ditto Royal Observatory.
Colombo	Editor of the *Ceylon Times*.
	Ditto *Ceylon Observer*.
	Surveyor General of Ceylon.
Constantinople	Director of the Observatoire Imperial Météorologique.
Copenhagen	Secretary to the Danske Meteorologiske Institut.
	Ditto Royal Danish Academy of Sciences.
Cordoba	Director, Meteorological Office.
Darjeeling	Conservator of Forests, Government of Bengal.
	Editor of the *Indian Forester*.
Dehra Dun	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Dublin	Registrar, Royal Dublin Society.
Edinburgh	Secretary to the Scottish Meteorological Society.
	Astronomer Royal for Scotland, Royal Observatory.
Ellichpore	Assistant Conservator of Forests, Melghat Division.
Goa	Director General, Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Guatemala	Director of the Observatorio Meteorologico del Institut Nacional de Guatemala.
Hamburgh	Director of the Nord Deutsche Seewarte.
Havana	Ditto Real Collegio de Belen.
Hong-Kong	Superintendent, Government Civil Hospital.
Indore	First Assistant Agent to the Governor General for Central India in charge of the Residency.
Iowa, U. S	Director of the Iowa Weather Service.
Jubbulpore	Civil Surgeon of Jubbulpore.

List of Recipients of the Publications of the Meteorological Office—continued.

Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests, Bombay, Sind Division.
Lahore	Secretary to the Government of the Punjab. Meteorological Reporter ditto ditto. Sanitary Commissioner ditto ditto. Conservator of Forests, Government of the Punjab. Editor of the *Indian Public Opinion*.
Lisbon	Director of the Observatoire de Infante D'Luiz. Secretary to the Academy of Sciences.
London	Secretary to the Meteorological Council. Ditto Royal Society. Ditto Royal Asiatic Society. Ditto Society of Arts. Ditto Meteorological Society. Ditto Institution of Civil Engineers. Librarian, Royal School of Mines. Ditto Admiralty Library. Ditto United Service Museum. Chief Librarian, British Museum. Editor of the *Philosophical Magazine*. Ditto *Athenæum*. Ditto *Nature*. Ditto *Symons' Monthly Meteorological Magazine*. Ditto *Westminister Review*. Ditto *Quarterly Review*.
Madras	Secretary to the Government of Madras. Ditto ditto Public Works Department, Irrigation Branch. Meteorological Superintendent to the Government of Madras. Government Astronomer, Madras. Sanitary Commissioner, Government of Madras. Registrar of the Madras University. Editor of the *Madras Times*. Ditto *Madras Athenæum*. Ditto *Madras Mail*. Superintendent, Government Central Museum. Ditto ditto Firm, Saidapet. Surgeon General, British Medical Department. Ditto Indian Medical Department. Master Attendant of Madras.
Madrid	Director of the Royal Observatory.
Manchester	Secretary to the Literary and Philosophical Society.
Manila	Director of the Meteorological Observatory.
Mauritius	Secretary to the Meteorological Society.
Melbourne, Victoria	Director of the Observatory. Librarian of the University Library. President of the Public Library.
Mexico	Director of the Central Meteorological Observatory.
Milan	Ditto Royal Astronomical Observatory.
Munich	Ditto Royal Observatory. Ditto Royal Bavarian Academy of Sciences. President, Geographical Society. The Publishers of the *Deutsche Rundschau für Geographie und Statistik*.
Nagpur	Secretary to the Chief Commissioner, Central Provinces. Sanitary Commissioner, ditto. Inspector General of Education, ditto. Civil Surgeon, Central Jail.

List of Recipients of the Publications of the Meteorological Office—continued.

Nagpur	Conservator of Forests, Central Provinces.
Naini Tal	Ditto ditto North-Western Provinces and Oudh.
New Haven, Connecticut	Secretary to the Connecticut Academy of Arts and Sciences.
	Editors of the *American Journal of Sciences.*
New York, U. S.	Director of the Central Park Observatory.
Ootacamund	Conservator of Forests, Government of Madras.
	Editor of the *South of India Observer.*
Oxford	Librarian of the Radcliffe Library.
	Radcliffe Observer, Radcliffe Observatory.
Paris	Director, Observatoire Physique Central de Montsouris.
	Editor of *La Nature.*
	Director of the Physical Observatory, Meudon.
	Ditto Bureau Central Meteorologique.
Perpignan, France	President Commission Meterol. des Pyrénéss Orientales.
Perth, W. Australia	Surveyor General.
Pesaro, Italy	Director of the Royal Observatory.
Philadelphia	Secretary to the Franklin Institute.
Poona	Conservator of Forests, Bombay Northern Division.
Prag, Bohemia	Director of the Observatory.
Raipur	Civil Surgeon of Raipur.
Rangoon	Secretary to the Chief Commissioner, British Burmah.
	Sanitary Commissioner, " " ditto.
	Conservator of Forests, ditto.
	Editor of the *Rangoon Times.*
Rome	Director, Meteorological Office (Ministry of Agriculture).
Saharanpur	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Ditto Chief Commissioner of Assam.
	Deputy Conservator of Forests, ditto.
Simla	Quarter Master General of India, Intelligence Branch.
Singapur	Colonial Surgeon, Straits Settlements.
Stockholm	Director of the Nautisk Meteorologiska Byran.
St. Petersburgh	Ditto Observatoire Physique Central.
Strasbourg	Librarian, Imperial University Library.
Sydney	Director of the Observatory.
	Librarian of the University Library.
Syracuse, Sicily	Director of the Royal Meteorological Observatory.
Tasmania	Secretary to the Royal Society.
Tiflis, Russia	Director of the Physical Observatory.
Tokei, Japan	Ditto Imperial Mining Office.
	Ditto Imperial Meteorological Observatory.
Toronto, Canada	Ditto Magnetical and Meteorological Observatory.
Turin	Ditto R. Osservatorio Astronomico di Torino.
Upsala	Ditto Meteorological Observatory.
Utrecht	Secretary to the Royal Dutch Meteorological Institute.
Vienna	Director of the K. K. Central Anstalt für Meteorologie und Erdmagnetismus.
	Ditto K. K. Geologische Reichsanstalt.
	Secretary to the Imperial Academy of Sciences.
	Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
Washington, U. S.	Chief Signal Officer, United States Army.
	Secretary to the Smithsonian Institution.
	Director of the Naval Observatory.
	Ditto Hydrographic Office.
	Professor Cleveland Abbe, Signal Office.
Wellington, New Zealand	Director of the Observatory.
Woolwich	Librarian of the Royal Artillery Library.
Zi-ka-wei, Schanghai	Director of the Magnetical and Meteorological Observatory.
Zurich	Ditto Central Meteorological Institute.

APPENDIX J.

Presentations to the Library from the 1st April 1881 to the 31st March 1882.

Place.	Donor.	Title of Work.
ALGIERS	Meteorological Service	Bulletin Météorologique du Gouvernement général de l' Algerie, Nos. 1915—2239, 2241—2279.
		Tableau récapitulatif des quantités des pluies; September to December 1880, and January to December 1881.
		Résumé climatologique, September to December 1880, Year 1880, and January to December 1881.
		Observations météorologiques du réseau Africain; Années 1878 and 1879.
		Quantités de pluie, September 1880 to August 1881.
		Sur les variations ou inégalités périodiques de la température; (dixiéme et onziéme Note), Période du vingtiéme jour dodécuplé.
		Le climat de l'empire Russe.
		Regime pluvial de l'Algérie; 1850—1880, and 1851 to 1880.
		Organisation actuelle du Service météorologique en Europe.
		Généralités sur la geographie and météorologie de l'Algérie.
AMSTERDAM	Royal Academy of Sciences	Processen Verbaal 1879-80.
		Jaarboek 1879.
		Verslagen en mededeelingen, afd Natuurkunde, Tweede Reeks, Vol. XV.
ALLAHABAD	Meteorological Office	Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1880-81.
		Sketch of the Meteorology of the year 1880 in the North-Western Provinces and Oudh and Eastern Rajputana.
BRUSSELS	Observatoire Royal de Bruxelles	Catalogue des ouvrages d'Astronomie et de météorologie en Belgique, 1878.
		Observations météorologiques, November and December 1879.
		Annales météorologiques—Deuxiéme Série, Tome I of 1876.
		Annuaire, 1880 and 1881.
		Observations des stations climatologiques; Année 1879, January to April 1880.
		Observations météorologiques faites aux stations internationales de la Belgique et des Pays Bas, June—December, and Résumé, 1879; January 1880.
	Royal Academy of Sciences	Bulletins, Tomes 46 to 50.
		Annuaire; 1879—1881.
	Dr. Fuchs	Géologie de la Belgique, par Michel Mourton.
	Ch. Feivez	Note Sur l'analyse de la lumiére de la comete (6) de 1881.
		Recherches Sur l'élargissement des raies spectrales de l'hydrogene.
BUDAPESTH	Central Anstalt für Meteorologie und Erdmagnetismus.	Jahrbücher, Band VIII, 1878; Band IX, 1879.
BOMBAY	Meteorological Office	Administration Report of the Meteorological Reporter for Western India for 1880-81.
		Brief sketch of the meteorology of the Bombay Presidency in 1880.
	Government of Bombay	Seventh Annual Report of the Sanitary Commissioner for the Government of Bombay in 1880.
	Government Magnetical and Meteorological Observatory.	Bombay Magnetical and Meteorological Observations, 1871 to 1878.
BERLIN	Meteorological Institute	Meteorologische Beobachtungen, January 1880.
BATAVIA	Magnetical and Meteorological Observatory	Rainfall in the East Indian Archipelago, 2nd year, 1880.
		Observations made at the Magnetical and Meteorological Observatory at Batavia, Volume V, parts 1 to 5.

Presentations to the Library from the 1st April 1881 to the 31st March 1882—continued.

Place.	Donor.	Title of Work.
COPENHAGEN.	Institut Météorologique Danois	Bulletin météorologique du Nord, May 1880; February to December 1881, and January 1882.
	Royal Danish Academy of Sciences	Oversigt No. 3 of 1880; 1 and 2 of 1881.
	Danske Meteorologiske Institut	Meteorologisk Aarbog for 1880, parts 1 and 3.
CARLSRUHE	Baden Meteorological Observatory	XII.—Jahresbericht der Grossherz. Badischen meteorologischen Central station Karlsruhe für das Jahr 1880; nebst mittle werthen für das Lustrum 1876—1880, und Fortsetzung des Literaturnachweises.
CALCUTTA	Government of India, Revenue and Agricultural Department	Codes of the Financial Department, Fifth Edition, 1881.
		General Report on the operations of the Survey of India during 1879-80.
		Suggestions regarding the management of the leased forests of Busáher in the Sutlej Valley of the Punjab.
		Imperial Gazetteer of India, Volumes I to IX.
		Report on the Coorg General Census of 1881, with Appendices.
		Appendix I to Famine Commissioners' Report—Miscellaneous papers bearing upon the condition of the country and people of India.
	Asiatic Society of Bengal	List of earthquakes recorded in Assam during the years 1879 and 1880.
	Marine Survey of India	General report on the operations of the Marine Survey of India for the year 1879-80.
	Government of India, Home Department.	On the manufacture of iron and the future of the charcoal iron industry in India.
		Report of the Meteorological Council of the Royal Society for the year ending 31st March 1880.
		A Manual of Indian Timbers. Gamble.
	Geological Survey of India	Memoirs, Vol. XVIII, parts 1 to 3; Vol. XIX, part 1.
		Manual of the Geology of India, Vol. III.
	T. S. Gardener, Esq.	The Typhoons of the Chinese Seas in 1880.
	Surveyor General of India	General report on the operations of the Survey of India during 1879-80.
		Supplement to the catalogue of maps, plans and charts of the Survey of India, published in 1878.
CALCUTTA	Government of Bengal	Annual Report of the Sanitary Commissioner for Bengal for 1880.
		Report on the external trade of Bengal with Nepal, Sikkim, and Bhutan, for the year 1880-81.
		Report on the internal trade of Bengal for the year 1880-81.
		Report on the Administration of Bengal for 1880-81.
	St. Xavier's College Observatory	Results of observations taken at the St. Xavier's College Observatory, January to December 1881.
		Diagrams of solar spots and protuberances recorded at the Solar Observatory, St. Xavier's College, from 1st December 1881 to 28th February 1882.
	Government of India, Military (Marine) Department.	General Report on the operations of the Marine Survey of India for the year 1880-81.
	Sanitary Commissioner with the Government of India.	Seventeenth Annual Report of the Sanitary Commissioner with the Government of India for 1880.
CORDOBA	Meteorological Office	Bericht über die geographischen ökonomischen commerziellen und politischen Verhältnisse der Argentinischen Republik; 1878 and 1879.
DEHRA DUN	E. McA. Moir, Esq.	Report of a visit to the torrent regions of the Hautes and Basses Alpes, and also to Mount Faron, Toulon.
	Great Trigonometrical Survey of India.	Great Trigonometrical Survey; Synoptical, Vol. X, Bider longitudinal series; Vol. XI Bilaspur meridional series; Vol. XII, Calcutta longitudinal series; Vol. XIII, East Coast series.
DUBLIN	Royal Dublin Society	The Scientific Proceedings of the Royal Dublin Society, Vol. II (New series), Part VII; Vol. III (New series), Parts I to IV.
		The Scientific transactions of the Royal Dublin Society, Vol. I (series II), papers Nos. XIII and XIV.

Presentations to the Library from the 1st April 1881 to the 31st March 1882—continued.

Place.	Donor.	Title of Work.
EDINBURGH	Robert Tennant, F.M.S.	On the motion of a storm in an easterly direction being only possible as a circular atmospheric wave.
GOTHA	Dr. E. Behen.	Geographischer Monatsbericht.
GOA	Meteorological Observatory	Observacões meteorologicas de Goa; 2nd Semestre do Anno de 1880.
GREENWICH	Royal Observatory	Greenwich magnetical and meteorological observations for 1879.
GUATEMALA	Instituto Nacional de Guatemala	Meteorological Observations, October 1879; March to May, September to December and résumé 1880; January to April 1881.
HAMBURGH	Duetsche Seewarte	Monatliche Uebersicht der Witterung, May to December and year 1879; September to December, and year 1880; January to September 1881.
		Wetterbericht, Band VI, Nos. 60-118, 120-131, 133-365; Band VII, Nos. 1 to 31.
		Aus dem Archiv der Deutschen Seewarte; II Jahrgang 1879; Jahrg. III, 1880.
	Dr. A. Sprung	Uber das Hadley'sche Prinzip.
HAVANNA	Real Collegio de Belen	Observaciones magneticas y meteorologicas, Año de 1874.
HONGKONG	Government of Hongkong	Meteorological Observations taken at Hongkong during December 1880, January to March, and July to December 1881; January 1882.
HYDERABAD	Resident at Hyderabad	Report on the Administration of the Hyderabad Assigned Districts for the year 1879-80.
IOWA	Iowa Weather Service	Iowa Weather bulletin, January to November 1881.
		Report for 1881.
		Iowa Weather Report for 1879, 2nd and 3rd quarterly numbers, and 1881 1st quarterly number.
LONDON	Meteorological Office	Weekly Weather Report, Vol. IV, Nos. 8 to 52; Vol. V, Nos. 1 to 7.
		Hourly readings from the self-recording instruments at the seven observatories, January to September 1880.
		Report of the International Meteorological Committee meeting at Berne, 1880.
		Daily Weather Reports from 1st July to 31st December 1880.
		Quarterly Weather Report (New series), part I, January to March 1876.
	G. M. Whipple Esq., B. Sc.	Results of experiments made at the Kew Observatory, with Bogen's and George's barometer.
		Variations of relative humidity and thermometric dryness of the air, with changes of barometric pressure at the Kew Observatory.
		Relative frequency of given heights of the barometric readings at the Kew Observatory, on Mr. Eaton's table of barometric heights at London, with regard to periodicity.
	Institution of Civil Engineers	Abstracts of papers in foreign transactions and periodicals, Vol. LIX, Session 1879-80, part [illegible]; Vol. LXVI, Session 1880-81, part 4.
	Society of Arts	Journal, Nos. 1476 to 1528.
	G. J. Symons, Esq.	Symons's Monthly Meteorological Magazine, March, May to October, and December 1881; January and February 1882.
	The Publishers of the 'Colonies, &c.'	The Colonies and India, Nos. 448, 449, 458, 463, 465, 468, 480.
	Royal Society	Proceedings, Vol. XXXI, Nos. 207 to 211; Vol. XXXII, Nos. 212 to 215.
	Meteorological Society	Quarterly Journal, New series, Vol. VII, Nos. 37 to 40.
		The History of the English Meteorological Societies, 1823 to 1880.
		List of Fellows of the Meteorological Society, January 19th, 1881.
		The snow-storms of January 17th to 21st, 1881.
		The Meteorological record, Nos. 1—3 of 1881.
		Hints to Meteorological Observers, with instructions for taking observations, and tables for their reduction.
		Index to the publications of the English Meteorological Societies, 1839-1881.

Presentations to the Library from the 1st April 1881 to the 31st March 1882—continued.

Place.	Donor.	Title of Work.
LONDON—*contd.*	Royal Asiatic Society	Journal, Vol. XIII, parts II, III, IV.
	Kew Committee of the Royal Society	Report of the Kew Committee for the year ending 31st October 1881.
	E. J. Mills, D.Sc., F.R.S.	Researches in thermometry.
LEIPZIG	Meteorological Observatory	Bericht über das meteorologische Bureau für das Jahr, 1880.
		Die Ergebnisse der Niederschlags-Beobachtungen in Leipzig und an einigen anderen Sächsischen Stationen, 1864-1881.
LISBON	Royal Academy of Sciences	Historia dos Estabelecimentos Scientificas Literarias, Artisticas, Tomo VIII and IX.
		Jornal de sciences, mathematicas, physicas e naturaes, Nos. XXIV to XXIX.
		Memorias da Academia, classe de sciences, mathematicas, physicas e naturaes, Nova Serie, Tomo V, parts I and II; Tomo VI, part I.
		Sessão Publica da Academia real das Sciencias de Lisboa em 9 de Junho de 1880.
MUNICH	Professor Dr. Carl Arendts	Deutsche Rundschau für Geographie und Statistic, Vol. III, Nos. 7 to 12; Vol. IV, Nos. 1 to 6.
	Baron Hermann von Schlagintweit-Sakünlunski.	Die Regenverhältnisse in Indien, nebst dem indischen Archipel, und in Hochasien, Theil I, Erläuterung der Untersuchungen. Die Beobachtungen in Nordlichen Indien von Ost gegen West and Theil II, Reihe A. Die Beobachtungen in centralen und in südlichen Indien. Reihe B. Die Beobachtungen in Ceylon, in Hinter Indien und im Archipel.
	K. Sternwarte	Meteorologische und Magnetische Beobachtungen; Jahrgänge, 1880 and 1881.
	Royal Academy of Sciences	Abhandlungen der mathematisch-physikalischen Classe, Band XIV, Abth I.
		Sitzungsberichte der mathematisch-physikalischen Classe, Band XIV, Abth I, Hefte 1 to 3 of 1881.
MANCHESTER	D. Winstanley, F.R.A.S.	Description of the Radiograph.
MEUDON (PARIS)	Observatoire de Meudon	Annuaire pour l'an 1882.
MEXICO	Central Meteorological Observatory.	Boletin, Tomo VI, Nos. 7 to 100 and 107 to 152.
		Revista Mensual Climatologica, Tomo 1, Nos. 1 to 3 and 5 to 9.
		Revista Cieptifica Mexicana, Tomo I, Nos. 13 and 15 to 17,
		Anales del Ministerio de fomento de la republica Mexicana, Tomo IV and V.
MONTSOURIS (PARIS)	Observatoire de Montsouris	Annuaire for 1882.
MORADABAD	Rev. G. T. Carruthers	A Theory concerning Sun-spots.
MELBOURNE	Meteorological Observatory	Monthly Record of results of observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne Observatory from September to December 1880, and in January and February 1881.
MAURITIUS	Royal Alfred Observatory	Mauritius Meteorological results for 1877 to 1880.
		Annual Report of the Mauritius Observatory for 1880.
NEW YORK	Meteorological Observatory	Abstract of registers from self-recording instruments for December and annual tables for 1880, and for January to November 1881.
PARIS	Bureau Central Météorologique de France.	Bulletin International, Vol. XXV, Nos. 49 to 237, 239 to 267, 269 to 271, 273 to 365; Vol. XXVI, Nos. 1 to 47.
		Supplement, Nos. 90, 151, 181, 212, 245, 273, 304, 334, and 363.
		Annales 1878; Tomes II and IV; 1879, Tomes I and IV.
	Société Météorologique de France	Annuaire, 28me Année, 1880, 3me Tremestre; 29me Annee, 1880 1er Tremestre.
	J. G. Détlmeida	Journal de Physique, théorique et appliqué.
PHILADELPHIA	Franklin Institute	Journal, 3rd series, Vol. CXI, No. 3 and Supplement and Nos. 4 to 6; Vol. CXII, Nos. 1 to 5; Vol. CXIII, No. 1, Vol. CIX, No. 4; Vol. CX, No. 3.
PRAGUE	Imperial Observatory	Astronomische magnetische und meteorologische Beobachtungen im Jahre 1880.
PERTH (WESTERN AUSTRALIA).	Survey Department, Meteorological Branch.	Western Australia, Meteorological Report for 1880.

Presentations to the Library from the 1st April 1881 to the 31st March 1882.—continued.

Place.	Donor.	Title of Work.
Rio de Janeiro	Imperial Observatory	Notice sûr l'observatoire impérial de Rio de Janeiro à propos de l'erection du nouvel observatoire Royal de Belgique.
		Bulletin, July and August 1881.
St. Louis	Washington University	Missouri Weather Service, March, May and July 1880, and February and April 1881.
		The Tornado of April 14, 1879.
		Report on the Magnetic observations in Missouri, Summer of 1879 and 1880.
		Thoughts on our conception of physical law.
Syracuse	Observatorio Centrale di Siracusa.	Osservazioni meteorologiche, Anno V, Nos. 1 to 12.
Sydney	Meteorological Office	Results of Meteorological observations made in New South Wales, from 1876 to 1879.
		Weather maps, 1877, 1878, complete; January to June 1879.
		Results of rain and river observations made in New South Wales during 1880.
		Thunder and hailstorms in New South Wales.
		Recent changes in the surface of Jupiter.
		Results of Astronomical observations made at the Sydney Observatory in 1877 and 1878.
		Papers read before the Astronomical section of the Royal Society of New South Wales, in 1878 and 1879.
		The Wentworth Hurricane.
	H. C. Russel, B.A., F.R.A.S.	The Gem cluster in Argo.
		Some new double stars and southern binaries.
		Note upon a sliding scale for correcting barometric readings to 32° and near Sea-level.
Simla	Inspector-General of Forests with the Government of India.	Review of the Forest Administration in the several provinces under the Government of India for the year 1879-80.
	The Hon'ble Whitley Stokes	Transactions of the Royal Irish Academy, Vols. XIX, XXIII and XXV, parts 2 to 8.
St. Petersburgh	Physical Central Observatory	Die Temperature-Verhältnisse des Russischen Reiches, von H. Wild. Supplement Band zum Repertorium für Meteorologie; zweite Hälfte nebst Atlas.
		Annales de l'observatoire Physique Central, Nos. 1 and 2 of 1879.
	A. J. Woeikof	Gletscher und Eiszeiten in ihrem Verhältnisse zum Klima.
		Études sur l'amplitude diurne de la témpérature, et sur l'influence qu'exerce sur elle la position topographique.
	International Polar Commission	Rapport sur les Actes et résultats de la troisiéme Conference polaire Internationale tenue a St. Petersburgh, pendant les jours du 1er au 6 Août 1881.
		Communications from the International Polar Commission, part I.
Stockholm	Royal Academy of Sciences	Sur la variation diurne de la force du vent par H. E. Hamburgh, parts I and II.
Toronto	Hugh V. Payne, Esq.	A storm sailing guide for the North Atlantic.
	Meteorological Office	Monthly Weather Review, February to December 1881, January 1882, and general Meteorological Register for 1881.
		Report of the Meteorological Service of the Dominion of Canada for the year ending 31st December 1879.
Tokei (Japan)	Imperial Meteorological Observatory.	Meteorological observations recorded at Wakayama, May to December and year 1880, and January to May 1881.
		Meteorological observations recorded at Hiroshima, April to December and year 1880, and January to September 1881.
		Meteorological observations recorded at Niigata, July to September 1881.
		Meteorological observations recorded at Nangasaki March to December and year 1880, and January to September 1881.

Presentations to the Library from the 1st April 1881 to the 31st March 1882—continued.

Place.	Donor.	Title of Work.
Tokei (Japan)	Imperial Meteorological Observatory.	Meteorological observations recorded at Kioto, October to December 1880, and January to September 1881.
		Meteorological observations recorded at Tokei, July to December and year 1880, and March to October 1881.
		Meteorological observations recorded at Tokei (weekly), 20th July to 31st December 1880.
		Results of the Meteorological observations recorded at Tokei for the lustrum 1876-80.
		Comparison of the results of observations made at the several Meteorological stations in Japan for the year 1880.
		Meteorological observations recorded at the several stations in Japan during the Typhoons of 13th-14th, and 26th-27th September 1881.
Tiflis	Physical Observatory	Beobachtungen der Temperatur des Erdbodens im Jahre 1880.
		Meteorologische Beobachtungen im Jahre 1880.
Turin	Osservatorio Astronomico di Torino.	Effemeridi del sole della luna e dei principali Pianeti calcolate per Torino in tempo-medio civile di Roma, anno 1882.
		Bollettino de l'osservatorio della regia Universita di Torino, parte Meteorologica, Anno XV (1880).
Utrecht	K. Nederlandsch Meteorologisch Institut.	Jaarboek 1876.
Upsala	Dr. Hildebrand Hildebrandsson	Bulletin mensuel de l'observatoire météorologique de l'université d'Upsal Volume XIII, Année 1880.
	Meteorological Observatory	Observations météorologiques faites par l'éxpédition de la Vega du cap Nord à Yokohama par le detroit de Behring.
Vienna	Dr. J. Hann	Zeitschrift der Oesterr. Meteor. Gesellschaft, Band XVI, March to December 1881; Band XVII, January and February 1882.
	K. K. Meteorologischen, Central Observatorium.	Wetterbericht, Vol. V, Nos. 86 to 365 and Vol. VI, Nos. 1 to 35.
	K. K. Geologischen Reichsanstalt	Verhandlungen, Nos. 12—18 of 1880, with title page, and Nos. 1-4 and 6-7 of 1881.
	K. K. Central Anstalt für Meteorologie und Erdmagnetismus.	Jahrbuch; neue Folge XVII, Jahrgang 1880, Erster Theil.
	Royal Academy of Sciences	*Bregina.*—Über die Meteoreisen von Bolson de Mapimi. Bericht über neue oder wenig bekannte Meteoriten; III.
		Ditscheiner.—Über die Aufsuchung der Störungsstellen an nicht vollkommen, isolirten Leitungen.
		Exner.—Die Theorie des Galvanischen Elementes. Zur Frage nach der Natur der Galvanischen Polarisation. Über Galvanische Elemente, die nur aus Grundstoffen bestehen; und über das elektrische Leitungsvermögen von Brom und Jod.
		Hann.—Die vertheilung des Regenfalls über Österreich in der Periode vom 11-15 August 1880, und deren Beziehung zur Vertheilung des Luftdruckes. Über den täglichen Gang einiger Meteorologischen Elemente in Wien (Stadt). Über den täglichen Gang des Luftdruckes, der Temperatur, der Feuchtigkeit, Bewölkung und Windstärke auf den Plateaux der Rocky Mountains.
		Hepperger.—Über den Einfluss der Concentration der Flüssigkeiten auf die elektromotorische Kraft des Daniell'schen Elementes.
		Hochstetter.—Ergebnisse der Höhlenforschungen in Jahre 1879.
		Prähistorische Ansiedelungen und Begrabnisstätten in Niederösterreich und in Krain.
		Hornstein.—Beitrag zur Kenntniss des Asteroidensystems.
		Horteweg und Julius.—Über das Grössenverhältniss der elektrischen Ausdehnung bei Glas und Kautschuk.
		Lisnar.—Über die Beziehung der täglichen und jährlichen Schwankung der Temperatur zur eilfjährigen Sonnenfleckenperiode.
		er—Über die Bahn des Kometen 1880 b.
		Niessl.—Theoretische Untersuchungen über die Verschiebungen der Radiationspunkte auf gelöster Meteorströme.

Presentations to the Library from the 1st April 1881 to the 31st March 1882—continued.

Place.	Donor.	Title of Work.
VIENNA	Royal Academy of Sciences	*Pernter.*—Über den täglichen und jährlichen Gang des Luftdruckes auf Berggipfeln und in Gebirgsthälern.
		Puluj.—Strahlende Elektrodenmaterie.
		Puschl.—Über die latente Wärme der Dämpfe.
		Reitlinger und Wächter.—Über Disgregation der Elektroden durch positive Elektricität und die Erklärung der Lichtenberg'schen Figuren.
		Schuhmeister.—Bestimmung magnetischer und diamagnetischer Constanten von Flüssigkeiten und Gasen in absolutem Masse.
		Stefan.—Über einige Versuche mit einem erdmagnetischen Inductor.
		Über das Gleichgewicht eines festen elastischen Körpers von ungleichförmiger oder veränderlicher Temperatur.
		Über die Verdämpfung aus einem Kreisörmig oder elliptisch begrenzten Becken.
		Tinter.—Zur Bestimmung der Polhöhe auf dem Observatorium der K. K. technischen Hochschule in Wien.
		Weiss.—Über die Berechnung der differential Quotienten der währen Anomalie und des Radius vector, nach der Excentricität in stark excentrischen Bahnen.
	* * *	Anzeiger.—Nos. 20-28 of 1880 and Nos. 1 to 19 of 1881.
VIZAGAPATAM	A. V. Nursingrow, Esq., F.R.A.S., F.R.G.S.	Results of meteorological observations taken at G. V. Juggarow Observatory, Vizagapatam, during 1880.
WELLINGTON	Meteorological Office	Abstract of meteorological observations in New Zealand; November and December 1880, and for quarters ending March, June, and September 1881.
		Meteorological Report for 1880.
		Statistics of the Colony of New Zealand for the year 1880, Meteorology.
WASHINGTON	United States Coast and Geodetic Survey.	Report of the Superintendent, Meteorological researches; Part II, on Cyclones, Tornadoes and Waterspouts.
	Chief Signal Office	Bulletin of international meteorological observations, 4th May to 24th July 1880.
		Monthly Weather Review, February to September 1881.
		United States Polar instructions.
		Report of the chief signal officer for 1879.
		Daily bulletin of weather reports, &c., June to August 1877.
	Smithsonian Institution	Smithsonian Report for 1879.
		On the Cyclones of January 1st to 4th, 1873.
	United States Naval Observatory	Meteorological observations made at the United States Naval Observatory during 1877.
		Reports of the total solar eclipses of July 29, 1878, and of January 11, 1880.
	Prof. Cleveland Abbe	Physics of the globe.
ZURICH	Swiss Meteorological Institute	Meteorologische Beobachtungen für 1878 and 1880, pp. 229-240.
		Ditto ditto an 16 stationen der Schweiz, January to December 1881.
	Francois W. C. Trafford	Souvenir de l'amphiorama on la vue du monde pendant son passage dans une cométe.
ZI-KA-WEI	Magnetical and Meteorological Observatory.	Bulletin mensuel; December and year 1880, and January to August and October to December 1881, and year.
		The Typhoons of the Chinese Seas in the year 1880.
		Sur l'inclinasion des vents; nouvelle gironette pour observer cette inclinaison.

Purchases for the Library.

American Journal of Science and Arts, Vol. XXI, Nos. 123-126; Vol. XXII, 127 to 132.
Annalen der Physik und Chemie, Nos. 3 to 12 of 1881 and Nos. 1 and 2 of 1882.
Comptes Rendus de l' Academie de Sciences Vol. LXXXVIII, Nos. 14 and 15; Vol. XCII, Nos. 4 to [illegible]; Vol. XCIII, Nos. 1 to 26; Vol. XCIV, Nos. 1 to 8, Index of Vol. XCI and Tables des Comptes Rendus.
Chambers' Mathematical Tables.
Deschanel's Natural Philosophy, by Professor Everett.
Encyclopœdia Britannica, Ninth Edition, Volumes I to IX.
La Nature, Nos. 406 to 457.
Lightning Conductors, their history, nature and mode of application, by Richard Anderson.
Nature, Nos. 593 to 636 and 639 to 644; title page and contents of Vol. XXIV and Binding covers of Volumes 15, and 17 to 24.
Philosophical Magazine, New series, Vol. XI, Nos. 68 to 71; Vol. XII, Nos. 72 to 74.
Report of the British Association for the advancement of Science for 1880.
Theory of Heat, by J. C. Maxwell.
Units and Physical Constants, by Professor Everett.

Government of India Central Printing Office—No. 81, Vol. [illegible]—2 11 82—400

REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1882-83.

THE year, to be dealt with in the present report, is the eighth that has elapsed since the re-organisation of the system of meteorological observations in India. It was foreseen, at the outset, that as, on the one hand, systematic observation should lead up to definite lines of enquiry, and, on the other hand, the demand for prompt and trustworthy information should increase with the growth of public interest in the current weather statistics of the country, so the work of the Department would necessarily expand both on its collecting and distributing sides; and, as this and previous reports will show, this expectation has been fully justified by the event. The area of observation which, in 1875, comprehended little more than the provinces under the principal Local Governments of India proper, some of which, moreover, were very imperfectly represented, now extends to the Native States both in India and around its borders, to the shores of Africa and the Persian Gulf, and comprises also all accessible parts of the Burmese peninsula; and, through Mr. Eliot's exertions, it has lately been extended, on an experimental scale, to the waters of the Bay of Bengal; while a beginning has been made to reduce and collate the mass of observations of past years, relating to Indian seas, which have accumulated in the London Meteorological Office, and to obtain therefrom the facts of the normal meteorological conditions of these seas, so indispensable to the explanation of those of the land area.

On the other hand, a considerable development has been given to the daily and other periodical reports, which are not only more numerous and comprehensive, but also more widely circulated than in previous years; while the descriptive portion of the daily reports is communicated daily by telegraph to all the principal seats of Government. Periodical summaries of the weather are now issued in anticipation of the detailed annual report, which forms its permanent record. And, in Bengal, preparations were in progress, at the cost of the Local Government, to establish a provincial system of daily telegraphic report, to be administered by the local Reporter; the object of which is to furnish the

Government with more prompt and detailed information than that yielded by the weather bulletins of the Imperial Government. This system has been brought into operation since the close of the year.

The arrangement of the present report will be similar to that of its predecessors of the last two years. The first part will notice the more important topics which have received attention during the past year; and the second part will recount the details of the administration. The several provincial reports are given in the Appendices.

SOLAR PHYSICS.—The report of the Committee on Solar Physics, appointed by the Lords of the Committee of Council on Education, which has been recently issued, shows that Indian observers have made considerable contributions to many of those subjects which have engaged the attention of the Committee. Previously to the appointment of the Committee in 1879, the connexion between solar phenomena and those of terrestrial magnetism had been made the subject of discussion by the late Mr. J. Allan Broun and Mr. Charles Chambers. And the relations of meteorological phenomena, more especially of barometric pressure and rainfall, to the variations of the solar surface, had been investigated by the same writers, and also by Messrs. Archibald, F. Chambers, Eliot, Hill, Hunter, and myself. Moreover, with respect to the direct registration of solar phenomena, a correspondence with the India Office in 1877, had led to the despatch of Mr. Meins as solar photographer to India in that year; and furnished with a photo-heliograph, similar to that employed at Kew, which is adapted to take pictures of the solar disk 4 inches in diameter, Mr. Meins was employed, at Dehra, under the direction of the Surveyor General, in taking daily photographs of the sun, up to the date of his death in March 1879. After this sad event, an interval of nearly nine months elapsed, during which the work was interrupted; but the experience, already gained, having demonstrated the very great advantages, presented by India, for obtaining photographic records of the solar surface,[1] Sergeant White, of the Royal Engineers' Corps, was sent out at the close of 1879, and he has since carried on the work under the superintendence of Mr. J. B. N. Hennessey, M.A., F.R.S., Deputy Superintendent of the Survey of India. A large photo-heliograph, suitable for taking pictures of the solar disk 12 inches in diameter, has since been supplied to the Dehra observatory; and some additions have been made to the smaller instrument, rendering it capable of taking pictures 8 inches in diameter.

The detailed reports on these photographic operations are given in the Annual Reports of the Surveyor General; and they are referred to here, only as being closely connected with work, in which the Meteorological Department has also borne its share. The question with which meteorology is immediately and profoundly concerned, is that of the variations of the radiant energy of the sun. The observation of the maximum temperature, shown by a thermometer, with the bulb coated with lamp black and enclosed in an exhausted tube, when exposed to the sun, has, from the beginning, been a part of the daily work at all Indian observatories. But this, at best, affords but a very rough indication of the local intensity of the sun's rays; and it is still a question whether, by any precautions, it can be made to serve as a measure of the original radiant energy of the sun. Such attempts as I have made to utilise the observations, for this purpose, in 1875, and again during the past year,[2] have resulted in a very partial and somewhat dubious

[1] According to the return given in the report, out of 384 days in India, only 42 yielded no photograph; whereas at Greenwich, out of 387 days not less than 244 were blank days.

[2] Journal of the Asiatic Society of Bengal, Vol. LI, Part 2, p. 72, 1882.

success; and a subsequent discussion of a portion of the data, by Mr. Hill, led to conclusions consistent in themselves, but apparently conflicting with those obtained by other methods.

It is then to more efficient instruments, such as the actinometer invented by Professor Balfour Stewart, that we look for more trustworthy information. Regular observations, with an instrument of this kind, were commenced in the latter part of 1879 at the Alipore Observatory, Calcutta; and after some tentative variations of method, a system of observation was begun in April 1880, which, with but slight modification, has been continued up to the 15th February 1883, when it became necessary to stop the work, in order to meet the requirements of the more important operations about to be undertaken at Leh in Ladakh.

Two years' results of the Alipore observations, after reduction, have been sent home to the Solar Physics Committee, and those of the first year have been published as an Appendix to the Committee's report. The second year's series, April 1881 to March 1882, taken on clear days only, show a slight increase in the intensity of the solar heat, as compared with those of clear days in 1880-81; an increase, which Professor G. G. Stokes considers to be too systematic to be the result of accidental circumstances. But the experience gained shows that the atmosphere of Calcutta is but ill-fitted for observations of such delicacy; and although I regret that circumstances have obliged me to bring them to a close, it is not possible to cherish the idea that they could ever be of high value, as indicating variations in the solar intensity.

I have now to recount the steps that have been taken to establish an actinometric observatory in the more promising atmosphere of Western Tibet, at an elevation of 11,500 feet above the sea. In a report by Professor G. G. Stokes, Professor Balfour Stewart, and General Strachey, presented to the Lords of the Committee of Council on Education in December 1877, the suitability of Leh, for observations of this class, was pointed out; and it was suggested that a sapper, trained in the use of the instruments, should be sent to India to carry out the work. The advantages to be gained by the selection of a station in a notoriously dry climate, with a clear atmosphere[1] and freed from the heat absorption of 11,500 feet of the lowest and densest part of the atmosphere, are sufficiently obvious, when it is considered that the variability of the atmospheric absorption and of its opacity to the sun's rays, is the one great obstacle to the measurement of the solar heat. And indeed direct proof of the supreme advantages for actinometric work, presented by a mountain station in a dry climate, has been recently obtained by Professor

[1] The clearness of the atmosphere from dust haze has been called in question by M. de Nicéville in some remarks printed in the Proceedings of the Asiatic Society of Bengal for February 1883; but the report adds that, while this dust haze is particularly remarkable in the valleys about Leh, an ascent of a few hundred feet carried one quite clear of it. This fact is confirmed by the evidence of Dr. Cayley, who resided at Leh during the greater portion of the year, for four years, and whose opinions are quoted by General J. T. Walker in a letter printed as Appendix E to the Solar Physics Committee's Report, in the following terms—"I believe, from much experience of the climate, that few better places in the world can be found than Leh, for any sun observation. The number of cloudy days in the year is very small. One may say that from early April to October there are almost none. The air is perfectly dry and free from moisture, and without vapour of any kind. There is not, on an average, above 2 inches of rain. During the five winter months, there is more cloud and some snow, but still comparatively little; nothing like the more southern Himalayas; and there is far more of clear than cloudy weather.

"As to dust, there is often a good deal of dust and sand blowing up in the valley of the Indus, below Leh, in the windy part of the afternoon; but it is very partial and never obscures the sky; and at Leh itself, which is between 4 and 5 miles up a side valley, and is surrounded by cultivated and irrigated fields, there is no dust at all; the air is always perfectly transparent, so that the most distant mountain peaks are as sharply defined as if they were close at hand."

Langley in Colorado, whose observations may be said to have revolutionised the views previously held as to the extent and distribution of energy in the solar spectrum.

Accordingly, in the report which I addressed to Government on the 8th June 1881, I recommended the adoption of the suggestion put forward in the report above quoted, and this recommendation having been approved and sanctioned by Government, (Proceedings, Department of Revenue and Agriculture, of the 27th October 1881), the Right Honourable the Secretary of State was moved to obtain the services of a trained observer, through the assistance of the Solar Physics Committee. As the results of these measures, Sergeant Rowland, a non-commissioned officer of the Corps of Royal Engineers, was instructed in the use of the actinometer at Kew Observatory, and provided with a passage to Bombay, where he arrived on the 31st October 1882.

As he arrived too late in the season to allow of his proceeding to Leh before the closing of the passes, I placed his services at the disposal of Mr. J. B. N. Hennessey, who was engaged in actinometric observations at Mussooree, and who very kindly undertook to employ him on the work, to train him in the use of meteorological instruments, and also to superintend the verification of the actinometers which Sergeant Rowland was to take with him to Leh. An assistant having also been sanctioned to accompany Sergeant Rowland, Mr. Hennessey further undertook to select and train a European youth, Mr. H. G. Shaw, who has been appointed after undergoing satisfactory probation.

I have lately heard from Mr. Ney Elias, at Leh, that quarters are prepared for Sergeant Rowland and the assistant; and they are now only delayed for the verification of a further supply of instruments, to replace the breakages that have almost annihilated the stock originally supplied for their work. These arrived at the end of May, and as soon as their verification is complete, the observers will start on their journey.

The enforced retention of Sergeant Rowland and Mr. Shaw at Mussooree and Dehra is by no means to be regretted. In a letter recently received from Mr. Hennessey, he writes—"Sergeant Rowland is going on working regularly, receiving a thorough training and acquiring delicacy of touch and keenness in observing the aspect of the sky, without which his results would have been useless. He could have sent home, anyhow, a large mass of readings, no doubt; but they would have been misleading and useless. I am sure it needs a highly trained, expert and keen observer to make out anything trustworthy of solar radiation."

A further reason for doubting whether any useful results could have been obtained by Sergeant Rowland, had he at once departed for Leh, on his arrival in India, is that the thermometers sent out for use with his actinometer, on the integrity of which his work was dependent, have proved, on trial, in great part a failure. Of the six instruments, one arrived cracked, and three others have since broken without assignable cause, owing probably to bad annealing. And as the remaining two have been accidentally destroyed, he would probably have been left without the means of observing. The supply ordered to replace these, which has just arrived, are by Messrs. Casella, whose instruments, previously supplied, have proved excellent. A report on the failure of those by the other maker has been sent to the Indian Store Department.

In conclusion, I desire to express my great indebtedness to Mr. Hennessey for his assiduous exertions to ensure the success of Sergeant Rowland's mission.

SNOWFALL REPORTS.—A department of observation, the importance of which, in connection with Indian meteorology, was, as far as I am aware, hardly suspected before

1875, (when, for the first time, the weather phenomena of the whole country were brought together, and investigated as a systematic whole), but which the experience of each additional year has tended more and more to bring into prominence, is that of the condition, extent, and persistence of the Himalayan snow-fields. When we consider how great is the contrast in the behaviour of a snow sheet, and a bare rock surface, and how differently they affect the superincumbent atmosphere, when equally exposed to the ardent radiation of a sub-tropical sun; and when, therewith, we note the fact, that on the northern limits of India, there is an area many thousands of square miles in extent, around the permanent *nevée* and glaciers, which alternates between these two conditions, accordingly as the winter and spring snowfall is copious or scanty, the idea that these differences must exert a potent influence on the meteorology of the plains is sufficiently obvious. But, as a fact, it was not until, in writing the report on the meteorology of the Madras famine year (1876), my attention was forcibly drawn to the unusual persistence of dry north-west winds in North-Western and Western India, and that, in the course of the discussion, a connection was traced between these winds and the anomalously high pressure and low temperature of the North-West Himalaya and the Upper Punjab,[1] that their probable dependence on the late and copious snowfall of the spring of that year, was first definitely suggested to my mind. From that time, as far as information has been forthcoming, the subject has been kept steadily in view. The winters of 1876-77 and of 1877-78 were characterised by heavy falls of snow, and in a still more marked degree,[2] in the latter season, more especially in Kashmir and Western Tibet; and in 1877, the summer monsoon was unusually weak and the rains failed almost entirely in North-Western India;[3] while in 1878, they were greatly retarded, and throughout the Gangetic plain and in Central India very deficient.[4] These three years affording positive evidence of the coincidence of a copious and late snowfall with deficient and retarded monsoon rains, were followed by a remarkably dry and snowless winter and spring in 1878-79; and, save in some parts of the Punjab and Bengal, abundant monsoon rains in the latter year.[5] The year 1880, which succeeded, afforded two instances of somewhat remarkable evidence bearing on the matter in hand. In the first place, a copious, but not very prolonged, fall of snow on the Himalayas in February, accompanied with cloudy weather, rain, and unusual cold throughout Northern India, was the immediate forerunner of three remarkably hot and dry months. But at the end of June and in July there was some very heavy rain on the North-West Himalaya, and, what is very unusual at this season, a copious fall of snow on the higher ranges, of which reports were received from residents in Kashmir and Lahoul. The month of August, which followed, to quote the words of the report on the meteorology of that year, "was in the latter half almost rainless, in the greater part of Northern India, and dry westerly winds set in, which recalled, for the time, the disastrous seasons of 1876 and 1877 and seemed to justify the most gloomy forebodings."[6] The winter of 1880-81 again was one of light snowfall. A moderate fall took place in March, up to which there had been scarcely any; and April and May were dry and seasonable, characterised by hot land winds of somewhat more than usual steadiness.

[1] Rep. cit. page 96.
[2] Report on the Meteorology of India in 1876, p. 97; Ditto of 1877, pp. 158 and 171; Ditto of 1878, pp. 147, 148.
[3] Ditto ditto in 1877, pp. 138 seq. 159.
[4] Ditto ditto in 1878, pp. 135, 137, 141, 149.
[5] Ditto ditto in 1879.
[6] Ditto ditto in 1880, p. 151.

The rains set in and also came to an end somewhat earlier than usual, but the rainfall, with merely local exceptions, was well up to the average, and in most parts of Northern India somewhat above it.

The meteorological history of 1882 has yet to be written; but as far as general experience admits of an opinion, it afforded no evidence adverse to the conclusion, to the soundness of which the previous years testify in so striking a manner.

Thus it appears that, since attention was first directed to the subject in 1876 and 1877, experience has uniformly confirmed the justice of the view put forward tentatively in the report on the meteorology of the former of these years. And therefore it becomes a matter of very high importance in the practical application of our meteorological system to the framing of forecasts of the rainy season, that very special steps be taken to obtain the fullest possible information on the extent and thickness of the snows; and more especially on their condition in the spring months, the period during which their slow or rapid decrease is of more immediate importance to the prospects of the ensuing rains. Some steps have already been taken to this end. Since 1880, an annual report has been regularly received from the Commissioner of Kumaon, General Sir H. Ramsay, on the snowfall of the outer Himalaya; and occasional information of much value has been contributed by the British Joint Commissioner of Leh, Mr. Ney Elias, by the Deputy Commissioner of Chamba, Major Marshall, Sir O. St. John, and some other officers. Quite recently, *viz.*, in April 1882, a further communication was made by the Government of India to the Local Governments of the Northern Provinces, requesting that the attention of the civil officers and residents of Hill States might be particularly directed to this matter; and it was recommended that monthly reports on the state of the snows, on the passes and the higher ranges of the interior, should be drawn up from information to be obtained from native traders and travellers and others, and communicated to this office. But in order that these reports should receive that attention which the importance of the subject seems to demand, it is necessary that civil officers and others who are in a position to obtain and contribute this information, should be made aware of the objects which it is required to subserve, and that they should understand how and in what manner the snow-fields are conceived to influence the rainfall of the plains. Only thus will they become impressed with a full sense of the great administrative importance of the information required of them; and they will be led to obtain and forward information from the less accessible parts of the mountain tract, with the requisite fulness and frequency. And I would recommend therefore, that this and the next following sections of this report be embodied in a special circular; to be disseminated as fully as possible to all officers resident in the interior of the hills, of whatever rank or status, who may be in a position to obtain the required information.

THEORY OF DRY WINDS AND DROUGHT IN INDIA.—The observed facts are that a fall of snow on the hills is followed, as soon as the weather clears, by a considerable rise of pressure over the mountains, and frequently also over the north-western plains; and this rise is accompanied by a steady wind on the plains, from north along the foot of the hills; from north-west on the more distant plains. In the cold weather and early spring, when there is often rain simultaneously on the plains, there is also a considerable fall of temperature; but in April frequently, and generally in May, there is no rain on the plains, and any fall of temperature is restricted to the immediate neighbourhood of the hills In these months, the cooling effect of the snows is local, but it is also persist-

ent ; and since the snow reflects a large portion of the sun's rays, and that which is absorbed does not raise the temperature of the surface, nor that of the air resting on it, above the freezing point, this air remains denser and heavier than it would be over a bare rock surface. It flows away as a north-west wind, at a high level, towards the plains, communicating its high pressure and southward movement to the lower strata ; and thus the whole mass of dry air moves towards the region of low pressure, (which then exists over the plains of Behar, Bengal, and the peninsula), constituting the dry land winds, usually characteristic of the spring, and in seasons of unusual snowfall lasting into the summer months. These winds are hot, the heat being absorbed from the dry strongly heated land surface ; and the lower strata, thus heated, mingle by convection with the higher ; while the latter, descending, are also heated, partly by the compression which the air necessarily undergoes, partly by being brought within the heating influence ofhe gtround.

Such appears to be the theoretical explanation of the dry winds of North-Western and Western India. The distance to which they prevail depends, in part, probably, on foreign circumstances, especially on the relation of pressure between the sea and the land. And thus, as in 1876, they may extend far down the west of the peninsula, or, as in 1877, they may be chiefly restricted to Northern India. But wherever they prevail, they keep back the damp wind from the sea, and are the cause of drought, and when unduly and unseasonably prolonged, it may be of famine in the land.

Even when most persistent, they may not prevail absolutely without intermission, for, as Mr. Herbert Spencer has pointed out, all continued action against resistance tends to become intermittent and oscillatory ; but they predominate in proportion to the strength of the operative cause that produces them.

The above views have been arrived at by a gradual process of induction from the observations accumulated during the last eight years ; and the partial generalisations which have led up to them, and much of the evidence on which they rest, may be found in the pages of the Annual Reports and other publications of the Department. It now remains to verify, perhaps in some respects to modify and correct them. As representing the determining causes of famine, they are certainly far from exhaustive ; for in periods of severe and prolonged drought, such as the two years, August 1876 to August 1878, there were causes in operation, of far wider incidence than any which have their seat in the Himalaya. But even as throwing a partial light on the cause of drought, the theory appears to me to have such claim to consideration, as to make more special study of Himalayan meteorology a matter of considerable moment.

HIMALAYAN METEOROLOGY.—From what has been said in the preceding paragraph, it follows that the more special study of the meteorology, or, more definitely, the atmospheric physics of the mountain tract, promises to become of peculiar importance, in relation to the rainfall of the plains. We have, at present, nine observatories in the Himalaya, and there will shortly be ten, all but two being in the outer ranges. The registers, afforded by these, are fairly satisfactory ; in one or two cases, equal to the best yielded by observatories of their class. But they are, of necessity, situated at the hill stations, and the registers of wind direction and force, more especially, and to some extent of other elements, are all more or less influenced by purely local conditions, such as the directions of the valleys, the intervention of neighbouring elevations, &c. Moreover, it is not feasible to obtain good and regular observations of clouds, the state of the atmosphere as regards haze, and especially the movements of the mass of the atmosphere above the

level of the hill-tops. It is observations of this class, made by a trained meteorologist, who reasons, while he observes, that are now the great desideratum ; and I think the time has come, when the propriety of establishing a first class observatory on some prominent hill-top, under the personal direction of a trained resident meteorologist, who is a good observer, is deserving of serious attention. It should be in the North-West Himalaya, as it is this part of the range that seems to be most influential as affecting the meteorology of Western India. There are several eminences suitable for the purpose, such as the Chor, the Shali or Hatu, or even the summit of the Mahasu ridge. The selection of a site would involve considerations of ready accessibility as well as free exposure; but this is a point that would require further consideration. Such an observatory would necessarily involve a considerable expense, for it is not mere mechanical observation that is required, but the intelligent observation of a person versed in atmospheric physics ; and I think the importance of the work demanded would justify any reasonable outlay for this purpose.

In the interior of the Himalaya, we have the excellent observatory of Leh, which is admirably superintended by Mr. Ney Elias ; and I have lately equipped one at Kailang, at an elevation of 10,000 feet in the Chundra Bhaga valley. The Rev. Mr. Heyde, who has very kindly undertaken the superintendence of this, has been, during the past winter, at Leh ; and besides working himself at the observatory there established, has had a young Lahouli trained as an observer, who will accompany him to Kailang and undertake the work of observation. In the course of a few weeks, therefore, I expect this observatory to be at work, and we shall then have a very important station for furnishing information on the weather of the inner ranges, and reports on the condition of the spring snows. Two other observatories have been sanctioned, and I had hoped that Mr. Hill would have been able to establish one of these in Kumaon, but this has not as yet been practicable. Both Leh and Kailang are in valleys, and therefore subserve purposes quite different from those aimed at in the proposed observatory above noticed.

THE TEMPERATURE OF NORTHERN INDIA.—In Mr. Hill's Report on the administration of his department in the North-Western Provinces and Oudh,[1] mention is made of a piece of work which he completed shortly before the close of the year under report, *viz.*, the determination of the mean temperature and ranges of temperature in a large part of Northern India. He has collected and discussed all the existing records of temperature, and, after careful and somewhat laborious reduction and correction, he has laid down the results on charts, illustrating the distribution of the mean temperature of the year, that of each month, and the variations of the annual range of temperature. These are now in the lithographers' hands, and will be published, together with the descriptive memoir and the tabular data on which they are based, in the forthcoming part (II) of the 2nd volume of the Meteorological Memoirs.

The only previous charts of the kind are those issued, many years since, by the late Baron von Schlagintweit Sakünlünski, which, having been based on very imperfect data, have long since ceased to be regarded as other than a rough approximation to truth. As such, they were undoubtedly useful in their day.

One or two somewhat remarkable facts shown on Mr. Hill's chart of mean annual temperature may be here noticed. One of these is the low temperature, (after due allowance has been made for elevation,) of the region between Benares and Jubbulpore. The

[1] See Appendix B, page 61.

mean annual temperature of Benares is lower than that of Allahabad, Lucknow, or Patna; and that of Jubbulpore considerably less than that of Ranchi, Saugor, and even than Bikaneer, nearly 5° further north.

This is the more remarkable, that Jubbulpore is situated in the heart of India and is therefore under the conditions of a continental climate. Another tract of abnormal coolness lies immediately to the west of the Aravalli range. With these exceptions, the temperature, as a rule, increases from the coast steadily towards the interior; that portion that lies within the tropics having, however, a higher temperature than northern or extra-tropical India.

The annual range of temperature varies within the limits of India from only 40° at Bombay to nearly 90° at Mooltan and Dera Ismail Khan.

CHART OF AVERAGE RAINFALL OF INDIA.—In the report of last year, it was stated that steps were being taken to prepare a general chart of the average rainfall, and that some progress had then been made in the collection and reduction of the data. This work was completed during the last cold season, and a hand-drawn copy of the chart has been sent to the International Exhibition at Amsterdam; the original being handed over to the Lithographic Department of the Surveyor General's Office, for reproduction by lithography.

The original intention was to lay down the data on a contoured map of India; and with that view, a special map was compiled by the Surveyor General, from the data afforded by the Surveys, Railways, Irrigation Departments, &c. But it was found, on collocating the two charts of elevations and rainfall distribution, that it would be impracticable to represent both, with sufficient clearness, on one and the same sheet; and it has therefore been resolved to restrict each to the representation of one class of data.

The rainfall chart sent to the Amsterdam Exhibition was drawn on one of the maps of India, published by the Survey of India in two sheets, and on a scale of 64 miles to the inch. The lithographed chart for publication will be on the same scale. It will show the names of about 1,100 places, with the average rainfall of each, to the nearest integral inch; and the distribution of the rainfall will be shown by eight tints representing respectively the areas with an annual fall below 5 inches, from 5 to 10 inches, and further increments of 10 inches each up to 50 inches; finally from 50 to 70, 70 to 100, and above 100 inches. It will also show, by inscribed labels, the distribution of the rainfall according to season, which, as is well known, varies much in different parts of India. It is hoped that the lithographed chart may be completed for exhibition at Calcutta in the ensuing cold season.

The only general rainfall charts of India, previously published, as far as I have any knowledge, are *first* that drawn up by Dr. D. Brandis, the late Inspector General of Forests, in 1872, when engaged in the preparation of his work on the Indian Forest Flora, and published in volume II, No. 7 of *Ocean Highways;* and *second*, a revised edition of the same chart, prepared in my own office, and published in 1878.

The plan of these charts was almost identical. They represented the rainfall in four zones, *viz.*, with annual averages below 15 inches, from 15 to 30 inches, from 30 to 70 or 75 inches, and above 70 or 75 inches respectively. Dr. Brandis' original chart was on a small scale (264 miles to the inch) and gave the annual rainfall of 34 places. The Meteorological Office chart was on the same scale, and gave the annual fall of 106 places, but was based on the more extensive data of the 222 stations included in the

table of average rainfall, published in the meteorological report for the year 1876. Both aimed at showing only the broader features of the rainfall distribution; and this they did, with the best data at the time available. The new chart is, therefore, a great advance on anything previously accomplished.

That portion of the chart, which represents the Punjab, has been laid down separately on a larger scale, and is being lithographed as an independant chart for the use of the Punjab Government. Mr. Hill, the Meteorological Reporter to the Government of the North-Western Provinces and Oudh, prepared from the original data, which he had collected and reduced, the rainfall chart of his own province, also on a large scale; this was incorporated in the general chart, and the original is also being reproduced for the use of the Local Government. Similar provincial charts can now be furnished, if required, to any of the Local Governments of India.

DISCUSSION OF THE RAINFALL DATA OF PAST YEARS.—With this work, I have also made considerable progress during the past cold season, in the intervals of leisure allowed by other current work.

The description of the normal distribution of the rainfall, according to place and season, and the circumstances which determine it, is now nearly completed, and some progress has been made with that of its vicissitudes, and their causes. I distinguish four well-defined seasons of rainfall in different parts of India, *viz.*:—

1st.—The *spring storm rainfall,* which is chiefly restricted to the south and east of the peninsula, and the eastern half of Northern India. In Assam and Eastern Bengal, where it is heaviest, this passes by imperceptible gradations into—

2nd.—The *summer monsoon rainfall.*—This is emphatically the rainy season, except in the Carnatic and in Sind, and portions of the Punjab and Rajputana.

3rd.—The *autumn rainfall of the Carnatic*—Usually termed that of the north-east monsoon. But this appellation is shown to imply some misconception. It is really that of the transition from the summer to the winter monsoon; and it ceases when the north-east or winter monsoon is fairly established on the Coromandel coast.

4th.—*The winter rainfall of North-Western India.*—Of this well-known feature of Indian meteorology, no satisfactory explanation has, I think, ever been given; and its investigation has been not the least interesting part of the present enquiry. The general result at which I have arrived is, that the atmospheric disturbances, which bring about the winter rains, originate locally, and are determined by local evaporation in a still atmosphere. The vapour which is precipitated is, however, chiefly brought from the warmer lands and seas to the south, by the southerly winds, which always precede this rainfall, setting in towards the seat of diminished pressure.

Among the collateral results of the discussion, is the not unimportant conclusion, that local evaporation from the land surface, from rivers, irrigation tracts, swamps and perhaps forest, furnishes an appreciable quota to the vapour afterwards locally precipitated as rain. This appears from many considerations. The most salient instance of the fact is that furnished by the occurrence of occasional rain in Kashghar, where the only possible source of vapour is the evaporation from irrigated tracts. But India itself also furnishes many illustrative cases, among which, I would particularly mention the heavy spring rainfall of Assam, the increased precipitation along the course of the Indus, both in the Lower Punjab and Sind, and that also of the drainage basin of the Godavery. I am much inclined to the belief that the extension of the irrigation and tree-planting, more

especially in such arid tracts as are portions of the Punjab, Rajputana, and Sind, are gradually bringing about an appreciable amelioration of the climate.

The question of the causes of drought in India is one that I have not yet fully worked out. But it is evident that it mainly resolves itself into that of the causes which, in certain seasons, determine an undue preponderance of the dry land winds,—winds which, as far as India is concerned, originate, in great part, within the enclosure of the culminating mountain barrier. As regards Northern and Western India, these are the regular winds of the spring months; but in favourable seasons they retreat, and over the greater part of the area disappear before the summer monsoon; and seasons of deficient rainfall and drought are mainly, if not entirely, due to their unseasonable persistence. The data, hitherto accumulated, are perhaps hardly sufficient to elucidate more than some portions of the problem thus presented to us for solution, and it may be that the present field of enquiry must be considerably extended before we can clear up many points involved in the issue; but I feel that the statement of the problem is gradually becoming clearer and more definite, and this is at least an important step towards its ultimate solution.

REGISTRATION OF RAINFALL.—It is satisfactory to learn from Mr. Hill's Administration Report, that steps have been taken to improve the registration of the rainfall in the North-Western Provinces and Oudh, by the issue of a more trustworthy form of gauge than that hitherto in use. These gauges have been issued to all revenue stations, which send reports of rainfall direct to the Allahabad Meteorological Office; and in order to obtain more correct values for the registers of past years, the new and old gauges will be read for a year simultaneously, and thus the relative values and errors of the old gauges will be determined.

Further steps have been taken during the past year to extend the registration of the rainfall to portions of the country previously unrepresented, and the following new registering stations have been established :—

Sitlaha	in Central India	from January	1882.
Sohagpur	ditto (Rewah)	,, June	,,
Jushpur	in Tributary mehals of Orissa	,, April	,,
Gangpur	ditto ditto	,, June	,,
Jagdalpur	in Bastar	,, July	,,
Jeysulmere	in Rajputana	,, January	,,
Kilba	in Bussahir (N-W. Himalaya)	,, April	,,

A number of additional stations have also been selected from the lists of raingauge stations established by the Local Governments, and have been added to that of stations reporting to this office. This has been done in those parts of the country which were previously but sparsely represented, with a view to rendering the distribution of stations more uniform. Thus 2 have been added in the North-Western Provinces, 16 in Bengal, and 17 in Madras.

STORM RECORDS.—The study of the storms of Indian seas has received much attention from the officers of the Department, ever since its germ was planted, by the appointment of a Meteorological Committee by the Government of Bengal in 1864, and the still earlier labours of Piddington, in the same field of enquiry, rank among the classics of meteorological literature. Indeed, the foundations of the science of cyclonology was laid broad and deep by that active and devoted investigator, and his works will always

form a store-house of valuable observation, equally necessary to the meteorologist and the seaman. But the physical theory of the origin and development of storms, and of the conditions on which they depend, is a study of later date, and it is in this field, more particularly, that Mr. Eliot has done some of his most important work. During the last year, he has made a very important addition to his previous writings, in a paper printed in Part I, Volume II, of the Indian Meteorological Memoirs, giving the detailed history of a small cyclonic storm, which originated over the Bay of Bengal and thence travelled northwards across Bengal, in the third week of November 1878. The discussion is very exhaustive. It takes cognizance, not only of the meteorological conditions prevailing over the Bay itself, but also of those on the land area around; and this for many days prior to the first appearance of the cyclone, as well as during its development and progress to extinction; and the conclusions, drawn from this history and summed up in the final pages of the memoir, are not the less important, that they are confirmatory of those which had been similarly induced from the study of previous storms in the Indian area. Mr. Eliot shows that its origin, existence, and motion were due entirely to the atmospheric conditions of the area visited by the storm, and not primarily and mainly to those beyond the area of the disturbance; while the changes that, at the season of its occurrence, are usually in progress over the land, went on, but little affected by the local disturbance over the Bay. The determining conditions were precisely those which, partly on the authority of Mr Eliot's previous memoirs, and partly on that of my own investigations; I summarised in Part II of the *Indian Meteorologist's Vade Mecum*. These, in Mr. Eliot's words, were "approximate uniformity of pressure over the storm area in Bengal and at the head of the Bay," accompanied by light, and, in a part of the area, variable winds. Hence "abnormal ascensional air-motion, on a large scale over the southern portion, at least, of the area of light airs and calms * * followed almost immediately by heavy and continuous rainfall, which, for a considerable period, was limited to this area. The course of the cyclone across Bengal took place where the air-motion was relatively least, prior to its arrival.

Following Mr. Eliot's Memoir in Part I, Volume II, of the Indian Meteorological Memoirs, is a list of cyclonic storms recorded on the west coast of India or on the Arabian Sea, drawn up by Mr. F. Chambers, shortly before his departure on sick leave. Mr. Chambers records 70 storms; and these show that the distribution of storms in the Arabian Sea, according to the times of year, is very similar to that in the Bay of Bengal. His own remarks on the list are very brief, and therefore in a short memoir which will appear in Part II of the volume, I have drawn attention to some particulars which seem necessary to the proper comprehension of Mr. Chambers' list, and have also given the history of one cyclone, which is of particular interest, as having originated over the plains of Gujarat. It probably may be taken as a type of a class of storms, of which the list furnishes other examples. This paper is now in the press.

THE METEOROLOGY OF INDIAN SEAS.—The arrival of Mr. W. L. Dallas, appointed Scientific Assistant to the Meteorological Reporter to the Government of India, in September last, has enabled me to put in hand, the very important work of reducing and discussing, for publication, the observations collected during 20 years (1856-1875) by the London Meteorological Office; and which, after sifting, correction and reduction to true places, and arranged according to geographical position in systematic data books, at the cost of the Indian Government, were received in this office in January 1877 and November 1880.

Prior to Mr. Dallas's arrival, some preliminary steps, in dealing with the barometric data, had been taken by Mr. Eliot; and Mr. Dallas, on proceeding to Calcutta in the earlier part of last October, took up the work systematically, beginning with the barometric and wind data of the Bay of Bengal for the month of January. This portion of his work has recently been brought to a completion, and a chart of the Bay (and the sea southward to the equator), on which the distribution of barometric pressure and winds in January are laid down on a well-understood plan, is now ready, and will be exhibited (together, it is hoped, with similar charts for February and March) at the forthcoming International Exhibition in Calcutta.

In general, the methods, followed by the London Meteorological Office, in laying down the corresponding data on the charts of the Cape of Good Hope, have been followed in the present case. But with respect to the barometric data, since the diurnal oscillation is large in Indian seas, whereas the geographical differences are comparatively small, it has been found advisable to correct the barometric readings, recorded at different hours, to a mean diurnal value, before taking their general average. And in the case of the winds, inas much as the Calcutta office is unprovided with the elaborate machine by which, in the wind roses of the Cape charts, the mean wind force and the proportion of gales are shown as areas of radial sectors of a circle, a much simpler plan of representation has been adopted; and both wind force and gales are indicated by numerals, appended to a very simple form of wind rose, which gives only the wind directions and the proportions of calms.

In taking out the various data, Mr. Dallas has been careful to record the occurrence and courses of the cyclonic storms, which, though rare, are occasionally generated in the extreme south of the Bay in the month of January; and some additions have thus been made to the list of cyclones of the Bay of Bengal, published in 1877, in the Journal of the Asiatic Society of Bengal. Four cyclones, including one of some severity, are thus found recorded during the 20 years.

The collection of current meteorological data, for the Bay of Bengal, has been undertaken as a special branch of work by Mr. Eliot, in accordance with the proposals submitted in paragraphs 39 to 44 of my report 3S of the 8th June 1881, and sanctioned in Government orders (Proceedings, Revenue and Agriculture, of the 27th October 1881). Observations are regularly recorded with duly verified instruments, on board the light-vessels off the mouth of the Hooghly; and a form of meteorological return, supplied by the Meteorological Office, is handed by the pilot to the captain of every vessel which reaches the Sandheads, together with a circular, specifying the information which it is desired to obtain; *viz.*, extracts of the meteorological entries in the log-book, referring to the weather experienced in the sea, north of the equator. Mr. Eliot reports that a large number of captains have complied with the request of the Department, and that, up to the 31st March, 345 sets of returns were filled up and transmitted to the office, many of which are of great value. This information is entered in books, in such manner, that all the observations for one day are entered on the same page; the form most convenient for transferring it to the daily weather charts, drawn up from the data of the land observatories.

Mr. Eliot remarks that these extracts clearly indicate the truth of what he had previously surmised, *viz.*, that the weather in the whole extent of the bay (excluding the Andaman Sea) is fairly indicated by the observations taken at the coast stations, and that the progress of every important storm may be traced and followed, with more or less exactness, almost from its origin, from the shore observations.

STORM-WARNING SYSTEM, CALCUTTA.—The new system of storm signals, noticed in my report of last year, was brought into operation last August, after notification in the *Calcutta Gazette*. Under this system, signals giving warning of any dangerous storm near the head of the Bay, are hoisted at Saugor Island, Mud Point, and Diamond Harbour. But in Calcutta, only before the approach of a severe cyclone, with a storm wave of sufficient magnitude to be probably dangerous and destructive to shipping in the Port. On such occasions they will be hoisted at three stations, *viz.*—

The Port Commissioners' Office.

On a flagstaff at Seebpore nearly opposite the Fort.

On a flagstaff near the Government Dockyard, Kidderpore.

The system of signals, for stations below the port, is designed to distinguish between the violent storms which are restricted to the periods of the change of monsoon, (May, June, and October, November), and those feebler but more frequent storms which occur during the summer monsoon; and they will also indicate, generally, what part of the Bengal coast the storm is likely to cross.

Six storms were recorded during the past year; only two of which appeared to be of such strength, as to justify the hoisting of the signals.

STORM-WARNING SYSTEM, BOMBAY.—This system has been worked during the greater part of the year, by the Officiating Meteorological Reporter for Western India, Mr. Pearson; in the same manner as in previous years. Mr. Pearson has sent in a report recommending some extensions, which will be duly considered. I am, however, of opinion that, until the storms of the Bombay coast have been carefully studied in detail, in the manner that has been practised for many years in the Bengal side, and until much more information is gained respecting the origin and courses of these storms, it is premature to make any considerable alteration in the present system.

DAILY WEATHER REPORT.—The daily reports issued by the Government of India give the substance of the weather telegrams, received from 88 stations,[1] (including that of the place of publication), and during the rainy season, rainfall returns from 35 additional stations, together with a verbal descriptive summary. This summary was continued through the cold season, for the first time during the past year. Since May 1882, it has been telegraphed to the Local Governments, the Meteorological Reporters, &c., and upwards of 300 copies of the printed report are issued daily, to officials and others, including the divisional and district officers of the Northern Provinces of India, and those meteorological offices in Europe and elsewhere, that exchange publications with this Department.

An improved and extended system of daily report has also been established in Bengal, but did not come into operation until after the close of the year under report. Some account of it will be found in the Administration Report of the Meteorological Reporter for Bengal (Appendix A).

CALCUTTA TIME SIGNALS.—Up to the 8th May 1882, only one time-ball was worked from the Alipore Observatory, *viz.*, that over the Port Commissioners' Office. From that date, the new time-ball on the Semaphore tower, Fort William, was also brought into operation; and, except on a few days, on which the communications of one or the other ball were faulty, both time-balls have been dropped regularly ever since.

The arrangements for firing the time-gun by electricity are, I regret to say, not yet complete. The apparatus has been put in good order and works well, and it was set up

[1] Since increased to 93.

in an empty expense magazine on the time-gun bastion. The gunner was trained in its use by the officers of the Electric Telegraph Department; and when all was so far ready, it was found, shortly before the close of the year under report, that the apparatus required a fuze not usually kept in store. An indent for the proper fuzes was sent to the ammunition factory, and not being procurable there, was sent home, and I have not yet heard of the receipt of the supply.

THE ALLAHABAD OBSERVATORY.—The establishment of a first class observatory at Allahabad, which was originally sanctioned in 1875, and for which a costly meteorograph has been obtained from Europe more than two years ago, has, I regret to say, made but little progress. This, as appears from Mr. Hill's report, is owing to certain difficulties with reference to the site selected for the new observatory. As stated by Mr. Hill, "Plans for a building to accommodate the observatory and the Meteorological office are now being prepared in the Executive Engineer's office at Allahabad. But it is possible that the question of a site for the observatory may have to be re-opened; because, at the site already determined upon in he Muir College compound, no building, except one designed by the architect of the college, can be erected, without the possibility of injuring the College from an architectural point of view. I understand that, for this design, heavy fees are demanded by the architect, and hence the provision of an observatory is at a stand-still." The dilemma does not appear to be one from which an escape should present many difficulties, and meanwhile there is not a small risk that the value of much of the work already done at Allahabad may be sacrificed. The present observatory is at Mr. Hill's private house and must be removed, sooner or later. In order that the observations to be recorded at the future observatory may be rendered comparable with those made, for many years past, at the present site, series of comparative observations must be recorded continuously for one or two years at both; and this work has been in progress, for nearly fifteen months, with a view to the removal to the Muir College. As Mr. Hill remarks, "should a new position be determined upon, the observations of temperature and humidity which have been made at the College since the middle of April 1882, and are still being carried on, will be useless."

PART II.—OBSERVATORIES.

In the report of last year, 123 observatories were enumerated, as having contributed registers to this office up to the close of the year; including 12 attached to various Government offices, but not paid for by the Department, and six which were either private and independent establishments, or were worked by volunteers; the instruments only having been furnished by the Department. Four have been added to this list during the past year, *viz.* :—

Gopalpore and Kurnool in Madras (3rd class).

An observatory at Dehra Dun attached to the Forest School, primarily as a means of instruction to the Forest students.

And Tura in the Garo Hills (4th class).

And the old observatory at the Electric Telegraph Office at Darjeeling was suppressed in October, 1882, having completed a year's working, simultaneously with the new observatory at St. Paul's school.

Two other stations have also been provided with instruments, but have not yet sent in registers, *viz.* :—

Kailang in Lahoul (3rd class).
Seychelles Islands (ditto).

Excluding the two last, there were, therefore, 127 observatories, contributing registers during the year; which were distributed in the several provinces as follows :—

Indian Empire.

Bengal and Assam	23
N.-W. Provinces and Oudh	18
Punjab	11
Central Provinces	11
Berar	5
Central India and Rajputana	10
Bombay	14
Madras, Mysore, Coorg, and Hyderabad	17
British Burma	8
Bay Islands	2
Lakhadives	1
TOTAL	120

Extra Indian Settlements and Foreign States.

Nepal	1
Kashmir territories	1
Beluchistan	1
Goa	1
Persian Gulf	1
Aden	1
Zanzibar	1
TOTAL	7
GRAND TOTAL	127

Of the whole number, 3 were first class observatories, with instruments registering autographically;[1] 25 second class observatories; at all but two of which, in addition to observations at 10h. and 16h., hourly readings are registered on four (in some cases three) days in each month; and at all but one of these latter, synoptic observations are also registered daily at 7h. Washington mean time, (=18h. 1m. Calcutta mean time). The remainder, with four exceptions, are third class stations, registering two full sets of observations, (and in the case of certain of the Madras stations, three sets) daily. The four excepted stations—Chowringhee (Calcutta), Mongpoo, Demagiri, and Makhla—register only temperature, rainfall, and wind direction. The observatories may further be classed as—

	Class.			
	1st.	2nd.	3rd.	4th.
A—Government observatories with paid observers under the Meteorological Department	1	25	81	1
B—Independent or attached to Government offices, observers not paid by the Meteorological Department .	1	0	8	4
C—Private and foreign observatories	1	1	4	0
TOTAL . .	3	26	93	5

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character; and an important part of its work is the control of the time signals for the port of Calcutta. It is immediately superintended by the Reporter to the Government of India; and the establishment is under the immediate charge of the Chief Observer, Baboo Brojo Mohun Rakhit, B.A.

The work of the observatory consists of—

1st.—Continuous registration, by autographic instruments, of the duration of bright sunshine, of the atmospheric pressure, temperature, moisture (dry and wet bulb thermometers), wind direction, movement and pressure, and the rainfall.

2nd.—Periodical readings of the barometer, dry and wet bulb thermometers (including maximum and minimum), the raingauge and the actinometer, and estimates of cloud proportion. The temperature readings include those of the temperature of the air in shade, under a shed of the usual pattern, those of nocturnal radiation and insolation, and those of the ground at the surface, and at 1 foot and 3 feet deep.

3rd.—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporters for Western India and Madras; and the comparison of all barometers with the Calcutta standard.

4th.—The determination of the mean local time, by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port.

The observations of temperature at 4 feet and 40 feet above the ground, having been carried on for four years, were discontinued on the 1st April 1882, the palm stem, on which the elevated thermometers were set up, having become so decayed at top, as to be thought unsafe.

[1] These do not include the observatories furnished with anemographs only, which are more numerous.

The establishment, for the above purposes, consists of—

Babu Brojo Mohun Rakhit, B.A.	Chief Observer.
,, Khetra Mohun Mukerjee	1st Photo. Asst.
,, Mahendra Nath Bhattacharja[1]	2nd ditto.
,, Annoda Prosad Banerjee, B.A.	2nd ditto.
,, Mahendra Nath Banerjee	Observer.
,, Syam Lall Sen	Ditto.

2 Artificers.
1 Batteryman.
6 Servants.

The autographic instruments consist of the Kew barograph and thermograph, which register by photography, a Beckley's anemograph, an Osler's anemometer, and a Beckley's raingauge. During the past year, all the instruments have worked well; and since, on the recommendation of Major Waterhouse, Morgan's *argento bromide* paper has been substituted for the waxed paper previously in use, there has been a very great improvement in the photographic traces, which are now, as a rule, all that can be desired. The cost of this sensitized paper is no greater than that of the paper and chemicals, which it has displaced, while all the operations are simplified, and the Assistants have more time to devote to the observatory work. In every respect, therefore, the change has been most beneficial.

The following table gives a comparative review of the mean results of the autographic registers of the barograph and thermograph, and of the eye-readings of the barometer and thermometers, recorded at the same hours. The standard barometer has the cistern about 1 foot higher than the barograph, and the standard thermometers are exposed under a shed, open all round, while the bulbs of the thermograph are under a louvred pent-house against the north wall of the observatory.

Comparative mean reduced readings of barograph and standard barometer in 1882.

1882.	Standard barometer.					Barograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January	30·036	30·107	29·970	30·043	30·039	30·037	30·118	29·979	30·054	30·047
February	29·942	·017	·878	29·948	29·946	29·943	·020	·881	29·960	29·951
March	·846	29·918	·778	·860	·851	·853	29·927	·782	·868	·858
April	·749	·809	·677	·760	·749	·750	·817	·684	·764	·754
May	·703	·743	·622	·719	·697	·699	·750	·627	·719	·699
June	·536	·570	·475	·564	·536	·530	·570	·481	·560	·535
July	·510	·538	·446	·538	·508	·502	·537	·444	·538	·505
August	·617	·658	·560	·649	·621	·611	·661	·558	·648	·620
September	·697	·745	·632	·716	·698	·692	·749	·633	·716	·698
October	·776	·830	·724	·788	·780	·772	·827	·726	·783	·777
November	·952	30·008	·894	·968	·956	·936	·997	·881	·956	·943
December	·998	·054	·929	30·009	·998	·978	30·045	·919	·997	·985
Year	29·780	29·833	29·715	29·797	29·782	29·775	29·835	29·716	29·797	29·781

[1] To the 20th May 1882; after which, Babu Annoda Prosad Banerjee was appointed.

Comparative mean readings of the thermograph and dry bulb thermometer in the thermometer shed in 1882.

1882.	Thermometer in shed.					Thermograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	59·8	70·1	78·1	64·0	68·0	60·8	68·9	76·8	64·6	67·8
February	61·9	73·4	80·0	66·4	70·4	63·0	72·5	79·1	67·4	70·5
March	71·7	83·6	91·7	76·9	81·0	72·5	83·0	91·0	77·7	81·1
April	75·9	87·4	92·3	80·0	83·9	77·0	87·5	92·8	80·9	84·6
May	77·3	86·2	89·9	78·6	83·0	77·8	87·1	90·5	79·9	83·8
June	80·1	86·0	85·5	81·0	83·2	80·7	86·7	86·6	81·9	84·0
July	79·4	84·3	84·4	81·0	82·3	79·9	85·1	85·1	81·4	82·9
August	78·6	83·6	83·4	79·5	81·3	79·2	84·8	84·3	80·3	82·2
September	78·5	84·3	84·2	80·0	81·8	79·1	84·5	85·0	80·7	82·3
October	74·9	81·5	82·8	76·9	79·0	75·8	81·4	82·7	77·4	79·3
November	67·7	76·2	79·2	69·9	73·3	67·9	75·3	78·5	70·0	72·9
December	58·5	70·2	76·3	62·5	66·9	59·9	69·0	75·2	63·1	66·8
Year	72·0	80·6	84·0	74·7	77·8	72·8	80·5	84·0	75·4	78·2

Comparative mean readings of the thermograph and wet bulb thermometer in the thermometer shed in 1882.

1882.	Wet bulb in shed.					Thermograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	58·2	63·0	63·8	61·1	61·5	58·6	62·4	64·2	61·5	61·7
February	59·2	64·1	65·0	62·3	62·7	59·9	64·3	65·9	63·4	63·4
March	69·7	72·7	71·2	72·1	71·4	70·1	73·1	72·6	72·7	72·1
April	73·3	75·9	74·8	74·8	74·7	73·2	75·7	74·9	74·9	74·7
May	74·8	77·4	77·4	73·9	75·9	74·1	77·5	77·5	73·9	75·8
June	78·4	80·4	80·1	78·8	79·4	78·4	81·1	80·8	79·2	79·9
July	78·1	79·9	79·9	78·7	79·2	78·3	80·3	80·5	79·1	79·6
August	77·6	79·3	79·0	77·8	78·4	77·4	80·0	79·8	78·2	78·9
September	77·5	79·4	79·0	78·4	78·6	77·7	79·7	79·8	78·7	79·0
October	73·6	75·6	75·7	75·2	75·0	74·1	76·0	76·2	75·3	75·4
November	65·5	68·5	68·7	67·2	67·5	65·1	67·8	68·7	67·1	67·2
December	57·0	62·9	64·1	59·9	61·0	57·3	62·3	63·7	60·2	60·9
Year	70·2	73·3	73·2	71·7	72·1	70·4	73·4	73·7	72·0	72·4

Up to the 15th February 1883, the readings of the Stewart's actinometer were made on all clear days, as in the previous two years, at apparent noon and two hours before and after. From that date they have unavoidedly ceased, as the instrument was urgently required at Mussooree, as has been explained in the introductory portion of this report (p. 3). The results for the past year, after reduction, will be sent home to the Solar Physics Committee.

The sunshine recorder, an instrument for registering the duration of bright sunshine, by means of a glass globe which concentrates the sun's rays on a strip of card (burning a trace on it as long as the rays are sufficiently powerful), was brought into use on the 14th November 1882, and is an useful addition to the actinometer and solar thermometer.

The observations of ground temperature have been steadily continued, the thermometers being read three times daily, at intervals of 8 hours; hourly observations, from 6 A.M. to 10 P.M., were also made for 31 days each in the months of July and December. These show the course of diurnal variation in the rains and cold weather, (after graphic interpolation for the remaining night hours); and, together with the series recorded in March and April, which was mentioned in last year's report, afford data for the correction of the eight-hourly observations to true diurnal means. The following table gives the results of the eight-hourly readings of the three thermometers and the monthly means, together with the mean air temperature for comparison :—

Mean temperature of ground at Alipore in 1882-83.

Months.		Surface.			1 foot deep (old).			1 foot deep (new).			3 feet deep.			Means.			
		5¾ hours.	13¾ hours.	21¾ hours.	5¾ hours.	13¾ hours.	21¾ hours.	5¾ hours.	13¾ hours.	21¾ hours.	5¾ hours.	13¾ hours.	21¾ hours.	Air in shade.	Surface.	1 foot deep (old).	3 feet deep.
April	1882	79·0	110·5	84·0	85·6	86·0	87·0	...	...	...	84·9	85·0	85·0	84·3	91·2	86·2	85·0
May	,,	80·7	104·5	82·8	87·0	87·1	87·8	...	...	...	86·5	86·6	86·6	83·7	89·2	87·3	86·6
June	,,	83·3	95·0	84·6	87·2	87·1	87·6	...	...	...	87·1	87·1	87·1	83·8	87·6	87·3	87·1
July	,,	83·2	92·7	84·6	86·8	86·6	87·0	...	..	...	86·9	86·9	86·9	82·8	86·8	86·8	86·9
August	,,	82·7	92·5	84·2	86·1	86·1	86·4	...	...	...	86·6	86·6	86·6	81·9	86·5	86·2	86·6
September	,,	82·1	93·4	84·0	85·8	85·8	86·0	...	...	...	86·1	86·2	86·2	82·2	86·5	85·9	86·2
October	,,	77·5	90·8	79·5	82·8	82·8	83·0	...	...	...	84·6	84·6	84·7	79·2	82·6	82·9	84·6
November	,,	70·3	83·8	72·7	77·3	77·3	77·5	...	...	...	80·8	81·2	81·1	73·1	75·6	77·4	81·0
December	,,	61·3	77·6	64·7	70·7	71·0	71·0	...	...	...	75·6	76·1	76·0	66·3	67·9	70·9	75·9
January	1883	58·3	74·0	62·2	67·0	67·5	67·6	...	...	...	71·9	72·5	72·2	63·9	64·8	67·4	72·2
February	,,	62·5	78·9	66·5	69·6	69·8	70·3	...	...	..	72·7	72·9	72·8	67·5	69·3	69·9	72·8
March	,,	72·1	97·1	76·5	76·9	77·0	77·9	77·6	77·1	78·8	77·2	77·3	77·4	77·9	81·9	77·3	77·3
	Means	74·4	90·1	77·2	80·2	80·3	80·8	...	...	...	81·7	81·9	81·9	77·2	80·8	80·5	81·8

The table shows anomalies similar in kind to those noticed in the last two annual reports. The temperature, at 3 feet deep, is 4·6° in excess of that of the air and 1·3° above that at 1 foot deep. This last difference is, however, exaggerated, and the excess is partly due to the temperature of the 1 foot thermometer being lowered, about 0·6°, by the nocturnal convection of the air, within the tube which contains the thermometer. This subject will be noticed in the Report on the Meteorology of 1882.

The number of instruments verified at the Alipore Observatory during the year ending March 1883 is as follows:—

1.	Barometers				45
2.	Aneroid				1
3.	Dry and wet bulb thermometers				23
4.	Maximum thermometers for air temperatures				10
5.	Minimum	do.	do.	do.	25
6.	Do.	do.	for nocturnal radiation		41
7.	Solar radiation	do.			22
8.	Standard	do.			4
9.	Common	do.			10
10.	Six's	do.			1
			TOTAL		182

And the following is a summary of those received and issued by the Observatory Store Department:—

		Received.	Issued.
1.	Barometers	41	32
2.	Aneroid	1	1
3.	Dry and wet bulb thermometers	9	12
4.	Maximum thermometers for air temperatures	11	15
5.	Minimum do. do. do.	17	27
6.	Do. do. for nocturnal radiation	53	36
7.	Standard do.	2	2
8.	Solar radiation do.	5	17
9.	Actinometer (Stewart's)[1]	1	1
10.	Anemometers	15	5
11.	Anemoscopes	1	3
12.	Sling thermometers	10	0
13.	Six's thermometer	1	1
14.	Common thermometers	0	9
15.	Thermometers for Stewart's actinometer	0	2
	TOTAL	167	163

The time signals were given, during the whole year, by the ball on the Port Commissioners' Office, and also, since the 8th May 1882, by the new ball on the Semaphore tower on Fort William. Both balls have been dropped accurately on 237 days. On 45 days only one ball gave the signal, the other either having failed or not having been brought into use. Of the 83 remaining days 79 were Sundays or public holidays. On three days, prior to the 8th May, the single ball failed, and on one day both balls failed to act. The failures have been, in nearly all cases, due to some failure in the communicating wire, generally through accidental contact with a conductor.

[1] This was in use at Alipore.

The following is a return of the failures of each time-ball :—

Port Commissioners' Office.

Dates of failure.	Nature of failure.
22nd April 1882 . . .	Dropped 2·00 sec. too late
25th „ „ . . .	„ 1·25 sec. „
1st May „ . . .	Failed.
8th „ „ . . .	Did not drop correctly.
2nd June „ . .	From return signal it could not be ascertained whether the trigger was discharged at the hoisting signal and also at the dropping signal. Hence the working of the ball was doubtful.
1st July „ . .	Failed.
17th „ „ . . .	Do.
19th „ „ . . .	Doubtful.
20th „ „ . . .	Do.
21st „ „ . . .	Failed.
25th August „ . . .	Return signal at dropping unintelligible.
3rd Nov. „ . . .	Failed.
1st. Dec. „ . . .	Do.

Semaphore tower, Fort William.

Dates of failure.	Nature of failure.
13th May 1882 . . .	Failed.
23rd June „ . . .	Hoisted, but did not drop.
12th July „ . . .	Failed.
20th „ „ . . .	Did not drop.
25th „ „ . . .	Dropped many seconds after mean 1 P.M.
10th August „ . . .	Failed.
27th Nov. „ . . .	Do.
6th March 1883 . . .	Do.
7th „ „ . . .	Do.
8th „ „ . . .	Do.
21st „ „ . . .	Do.
22nd „ „ . . .	Dropped few seconds after mean 1 P.M.

For the reasons explained in the introductory portion of this report, the time-gun is not yet fired by electricity.

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—Including the old Darjeeling observatory at the Electric Telegraph Office, which was suppressed in October 1882, and the new fourth class observatory at Tura in the Garo Hills, which commenced work in

March 1883, there were altogether, in addition to Alipore, 22 observatories in these provinces, during the whole or part of the year. These were :—

Second Class.

Sibsagar.	Hazaribagh.	Cuttack.
Dhubri	Saugor Island.	Chittagong.
Bankipore.		

Third Class.

Darjeeling (1st Paul's School).	Burdwan.
„ (Electric Telegraph Office).	Jessore.
Purneah.	Dacca.
Durbhanga.	Silchar.
Gya.	False Point.
Berhampur.	

Fourth Class.

Calcutta (Chowringhee).	Tura.
Demagiri.	Mongpoo.

Mr. Eliot's Report, (Appendix A) gives the names of the Superintendents and observers at all the second and third class stations, and at Demagiri and Tura. The Chowringhee Observatory is attached to the Meteorological Office, the clerks of which take the observations, and Mongpoo is included in the special list (Appendix E).

Three of the second class observatories and all of the third class (excepting Jessore and Silchar) were inspected by Mr. Eliot, and a detailed account of the results of the inspection, as well as an opinion on the working of the remaining observatories, is given in his report. Cuttack, Dhubri, and Saugor Island are stated to be the best of the second class, and Berhampur, Dacca, Burdwan, Darjeeling, and False Point the same of the third class observatories. Hazaribagh and Bankipore (Patna), which were unfavourably reported on last year, have improved, but it has been necessary to dismiss the observer at the former station for deliberate falsification of his registers. Purneah has improved; and, as far as can be judged from the registers, Silchar and Jessore also, especially the latter; but Gya and Durbhanga are far from satisfactory.

The observatory at False Point was in abeyance from the 25th April to the 7th August, owing to the unexpected closing of the Electric Telegraph Office at Jumboo, at which the observatory was situated. No notice having been received of the intention of the Electric Telegraph Department to close this office, no arrangements had been made for transferring the instruments and the work elsewhere, nor could any satisfactory arrangement be made until, in August, the light-house at False Point was brought into telegraphic communication with Cuttack, when the observatory was re-established at this its original site. The temporary suppression was very prejudicially felt, as this is the station from which, in general, the earliest decisive report is received of any cyclone likely to approach Calcutta. For this purpose the telephone, although better than nothing, is very inferior to the Morse instrument, as communication fails in stormy weather.

Self-recording anemographs are at work at Darjeeling, Dhubri, Hazaribagh, Chittagong, Saugor Island, and Cuttack, as well as at the Alipore Observatory. At the first three stations and Cuttack, they are those of Casella's pattern; at Chittagong, Saugor Island, and at Calcutta those of Beckley's. The first instrument is found at these stations,

as indeed, elsewhere, to work unsatisfactorily in light winds, and indeed to be generally unsuitable for India. It was tried, as being only half as expensive as the Beckley; but the experiment has not been successful.

The following observers have been selected for especial allowances during the current year, that marked * being now awarded for the first time, while that marked † has been raised from Rs. 5 to Rs. 10 :—

Names.	Stations.	Amounts. Rs.
Mokhoda Prosad Chowdhri	Burdwan	10
J. C. Smith	Cuttack	10
Mohendro Nath Roy	Berhampur	10
† Maniruddin Ahmed	Dhubri	10
Dandadhur Datta Barua	Sibsagar	5
Jogin Chunder Banerjee	Durbhanga	5
* H. W. Alley	Cuttack	5

OBSERVATORIES IN THE N.-W. PROVINCES AND OUDH.—Excepting that an observatory has been estahlished at the Forest School, Dehra Dun, in addition to that already existing at the Office of the Survey of India, the observatories of these provinces are the same as were enumerated in the report for last year, *viz.* :—

Second Class.

Allahabad.	Lucknow.
Agra.	Roorkee.

Third Class.

Chakrata.	Dehra (Forest School).	Benares.
Ranikhet.	Bareilly.	Jhansi.
Mussooree (St. Fidelis).	Meerut.	Pauri.
Do. (S. G. Office).	Gorakhpur.	Pithoragarh.
Dehra (S G. Office).	Ghazipur.	

Mr. Hill's Report (Appendix B) gives the names of the Superintendents and observers, and the results of his inspection of Lucknow, Agra, Ranikhet, Bareilly, and Jhansi. He also remarks on the work of the other observatories. With the exception of Bareilly, where the instruments were dirty and neglected, and Jhansi, where the building was somewhat out of repair, the condition of the observatories is reported to have been generally satisfactory, and, with slight exceptions, the work of the observers is also favourably reported on.

The new difficulties that impede the provision of a building for the Allahabad observatory, and which threaten to render useless much of the work, already done, with a view to ensuring the continuity of the records, have been noticed in the introductory portion of this report.

Special allowances for satisfactory work have been allotted for the current year to the following observers :—

Names.	Stations.	Amounts. Rs.
Chotay Lall	Lucknow	10
Kadernath Chatterjee	Allahabad	10
† Jewa Nand	Ranikhet	10
Mir Altaf Ali	Agra	5
Saligram	Chakrata	5
* Chiranji Lal	Roorkee	5
Devakinandan Pathak	Benares	5

OBSERVATORIES IN THE PUNJAB.—No change has been made in the observatories of this province, which, during the past year, were as follow :—

Second Class.

Lahore.

Third Class.

Mooltan.	Sialkot.	Ludhiana.
Dera Ismail Khan.	Murree.	Simla.
Peshawar.	Sirsa.	Delhi.
Rawalpindi.		

The names of the Superintendents and observers are given in Dr. Lawrie's Report (Appendix C). The observatories of Simla, Delhi, Ludhiana, Rawalpindi, Murree, and Dehra Ismail Khan were inspected by Dr. Lawrie in September, but no details of the results are given in the report.

Lahore and Murree rank as the best observatories in the Punjab; Rawalpindi as the worst. The barometric readings of this last station have always been very untrustworthy, and, so late as January last, the readings were so anomalous as to necessitate their being returned to the Punjab office for report. No report has, however, yet been received; but of late there has been an apparent improvement, to judge from the telegraphic reports.

At Simla, I had occasion also to draw the attention of the observer to the systematic inaccuracy of the barometric readings, and on one occasion to an evident error in the rainfall report.

Dr. Lawrie reports that the year showed considerable improvement in the character of the work of all the observatories. To his remark that he has little or no complaint to make against any of the observers, I think, however, that the errors detected in my own office in the work of Rawalpindi and Simla, show that the observers of these stations must form an exception.

Special allowances for the current year have been awarded to observers as follow, the new recipients being designated by an (*) :—

Names.	Stations.	Amounts.
		Rs.
Fazal Rahman	Sirsa	5
Kashi Ram	Peshawar	5
(*) W. Cruikshank	Murree	5
(*) Jespat Rai	Lahore	5
(*) Divan Chand	Do.	5

OBSERVATORIES IN THE CENTRAL PROVINCES.—As in previous years, these are eleven in number, *viz.*, three of the 2nd and eight of the 3rd class, *viz.* :—

Second Class.

Nagpur. | Jubbulpore. | Pachmarhi.

Third Class.

Saugor.	Chanda.
Hoshangabad.	Sironcha.
Seoni.	Raipur.
Khandwa.	Sambalpur.

The report of the Deputy Surgeon General and Sanitary Commissioner, who locally controls these observatories, is given in the Appendix D I, and a nominal list of Superintendents and observers in Appendix D II. Appendix D III is some notes on the results of an official inspection of the observatories at Khandwâ, Jubbulpore, Seoni, Nagpur, Sambalpur, Raipur, and Chanda, by Dr. B. Simpson, who held the post of Deputy Surgeon General during the year under report.

The Saugor observatory was closed and the observations were in abeyance, from June to October. The native observer, Dindyal, had been repeatedly warned and fined for persistent falsification of his registers, by inserting imaginary readings of the barometer; and proving incorrigible, he was at length dismissed, on the 4th June 1882. A long delay ensued before another observer was selected and trained, and the work was not resumed until the 18th October. His work has proved so far satisfactory. As Dindyal's barometric registers, for more than two months prior to his dimissal, had to be rejected, there is altogether a hiatus of seven months in the registers of this station.

The observer at Jubbulpore, Banikanta Rai Chowdhri, who had been sent up from Calcutta, also proved unsatisfactory, and he was allowed to resign in June 1882. The work of the remaining observers has been generally satisfactory. The Raipur reports have been more frequently erroneous than those of other stations.

Special allowances have been allotted to the following for the current year :—

Names.	Stations.	Amounts.
		Rs.
T. V. Allaghiri Swami	Nagpur	10
Jadu Nath Bosu	Hoshangabad	5
Sham Soondar Dass	Sambalpur	5
Seetaram	Chanda	5
Puncham [1]	Seoni	5

Two stations, *viz.*, Nagpur and Jubbulpore, are provided with autographic instruments for registering the wind. That at Nagpur, a Beckley's anemograph, has worked in a very satisfactory manner; but that supplied to Jubbulpore, a cheaper form of instrument by Casella, has never yielded any useful results, owing to inherent defects of the design. These instruments have proved equally unsatisfactory elsewhere.

OBSERVATORIES IN BERAR.—There are five of these, as in the previous year, all of the third class, with the exception of Makhla, which is of the fourth class, and has been established by the Forest Department, but contributes registers to this office. They are—

Third Class.

Akola.	Chikalda.
Buldana.	Amraoti.

Fourth Class.

Makhla.

The list of Superintendents and observers, at the first four observatories, is given in the Table (Appendix F II), appended to the Report of the Officiating Meteorological Reporter for Western India, under whose control, jointly with the Sanitary Commissioner of the province, these observatories work. Those of Makhla are enumerated in Appendix E.

[1] Now first allotted.

Only one of the above has been inspected during the year, *viz.*, Amraoti, which was visited by Mr. Pearson, with a view to reporting on the proposed removal of the observatory to another site in the neighbourhood. With the exception of the anemometer and its registers, the instruments and the work of the observatory were found to be satisfactory.

The barometric registers of Chikalda are very inconsistent with those of other stations, and at present of little value. During two years they were vitiated by the condition of the barometer, the mercury of which had become thickly coated with oxide, so that accurate readings were impracticable; and even when these have been eliminated, the inconsistencies are only somewhat reduced, and by no means disappear. The Reporter for Western India has lately been requested to subject the whole to a careful examination.

The barometric registers of Buldana also, during the past year, are inconsistent with those of previous years, and with those of other stations in the neighbourhood, owing to some constant cause of error, which the Reporter for Western India has been requested to investigate.

The following observers have had special allowances allotted to them for the year now current :—

Names.	Stations.	Amounts.
		Rs.
† Samuel Gregory	Akola	10
Bukaram Pandurang	Amraoti	5

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—The number of these observatories is the same as during the previous year, *viz.*, ten; but one, Jeypore, established and maintained at the expense of the Jeypore Durbar, has been raised to the status of a first class observatory, by the introduction of autographic registration. The list is therefore as follows : —

First Class.

Jeypore.

Third Class.

Sutna.	Indore.	Ajmere.
Nowgong.	Mount Abu.	Sambhar.
Neemuch.	Pachbudra.	Bickaneer.

The Van Rysselberghe's meteorograph, purchased from the Government of India, for the Maharajah's observatory at Jeypore, was brought into working at the beginning of the year under report. Many difficulties have been met with; first, owing to some injuries which the instrument had received in transport, and afterwards in finding out the proper methods of working; but these were eventually overcome, partly by the skill of a native mechanician, Nand Kishore, a man of remarkable mechanical endowments, in the service of the Durbar, and partly by the intelligent assistance afforded by the local Electric Telegraph Master, Mr. Callaghan. It is, however, to Dr. Hendley, the Superintendent of the Observatory, that must redound the credit of having established the observatory and of having brought it to its present very efficient condition. Some minor difficulties remain yet to be overcome, before the meteorograph will furnish the printed facsimiles of the traces; difficulties partly arising from the action of extreme dryness and heat on the parts of the instrument; but a considerable series of successful records have already been obtained; and the same skill and energy, which have accomplished so much, will doubtless achieve complete success in the end.

The observatories at Sutna, Nowgong, Ajmere, aud Sambhar are under the Reporter to the Government of the North-Western Provinces; those of Neemuch, Indore, Mount Abu and Bickaneer under the Reporter for Western India; and the names of the Superintendents and observers are given in the lists of their respective Reports (Appendices B and F II). Pachbudra is under the Commissioner of Northern India Salt Revenue, and reports direct to the Central Office in Calcutta [Appendix E].

Jeypore was visited by myself in November, and by Mr. Hill in the following month; and Mount Abu, Neemuch, and Indore were inspected by Mr. Pearson.

The observatory at Mount Abu has contributed a continuous register since April 1882, but the barometric register is evidently erroneous; and although a large error was discovered in the readings of the barometer, when the station was inspected by Mr. Pearson, this does not account for those of the registers; which must, therefore, be rejected. In spite of the printed standing orders, with which every observatory is furnished, the observer was found to be taking his observations according to Madras time, and this was the case at several other stations under the Reporter for Western India.

At Neemuch, also, this practice of observing according to Madras time was followed, and the anemometer was somewhat injured; and at Indore, the same instrument was badly placed. Otherwise these two observatories were more satisfactory.

The Pachbudra observatory has been far from satisfactory, as was also the case in the previous year; and were it not that its suppression would leave the greater part of Western Rajputana, a region of especial meteorological interest, entirely unrepresented, I should have closed the observatory and withdrawn the instruments. The barometric registers of the past year are quite worthless.

The observatories, working under Mr. Hill's direction, *viz.*, Sutna, Nowgong, Sambhar, and Ajmere, are far more satisfactory. Mr. Hill mentions that the Sambhar observer sometimes makes mistakes, but these have been detected and eliminated in Mr. Hill's office, and the registers furnished by him are quite satisfactory.

Special allowances have been awarded to the following observers for the current year, on the recommendation of the Reporters. It appears, however, from Mr. Pearson's report, just received, that the claim of the Neemuch observer is doubtful, as he stands low on the list of merit.

Names.	Stations.	Amounts. Rs.
Har Nath	Sutna	5
(*) Ram Persad	Ajmere	5
T. Bachu	Neemuch	5
Ram Lall	Bickaneer	5

OBSERVATORIES IN THE BOMBAY PRESIDENCY.—The observatories, which contribute registers to this office, are the same as in the previous year, *viz.*:—

First Class.

Colaba. | Bombay.

Second Class.

Belgaum. | Deesa.
Poona. | Kurrachee.

Third Class.

Jacobabad.	Rajkot.	Ratnagiri.
Hyderabad.	Sholapur.	Karwar.
Bhuj.	Surat.	Malegaon.

The Colaba observatory is independent of the Department and only furnishes a register similar in form to those of Allahabad and Jeypore. The remaining stations are administered by the Reporter for Western India.

The four stations of the second class have all been inspected by the Officiating Reporter, Mr. Pearson. Excepting slight defects in the working of the anemographs, which the Reporter rectified, the observatories of Deesa, Poona, and Belgaum were found to be in good order. At Kurrachee, the observer practised an erroneous method of reading his barometer, which, however, when discovered, admitted of the recorded readings being corrected to true values.

Of the third class stations, Surat, Rajkot, Malegaon, Hyderabad (Sind), Jacobabad, Sholapur, and Ratnagiri were also inspected, and some notice of the results of each inspection are given in Mr. Pearson's Report (Appendix F).

Of these, the Ratnagiri observatory was the only one found to be in satisfactory condition, and properly worked. At Malegaon, the barometer was not vertical; at Surat the radiation thermometers were covered with a wire netting, and the observer misread his anemometer; at Jacobabad, the nocturnal radiation thermometer was read without being exposed, and had a divided column; at Sholapur, the barometer cistern was never adjusted and the instruments dirty; at Rajkot, the anemometer was out of order; and at Surat and Malegaon, Madras time, and at Sholapur, Bombay time, was observed instead of true local time. As all these practices are subjects of particular notice and special warning in the printed instructions furnished to all observers, their existence implies very reprehensible negligence on the part of the observers.

Before the receipt of Mr. Pearson's Administration Report, special allowances had been awarded to the following observers; those marked (*), this year, for the first time. Having regard to the circumstances above noticed, it is under consideration whether those granted to Narayan Mane and Dhunjibhai Mutabhai should not be reduced or withdrawn.

Names.	Stations.	Amounts. Rs.
Narayan	Jacobabad	10
Mahadev Cuddum	Ratnagiri	5
Dhunjibhai Mutabhai	Surat	5
(*) Solomon Samuel	Rajkot	5

OBSERVATORIES IN MADRAS, MYSORE, COORG AND HYDERABAD.—Of the three additional observatories, sanctioned in October 1881, one, *viz.*, at Kurnool, has been established during the past year, raising the number in these provinces to seventeen, which are as follow:—

Second Class.

Vizagapatam.	Bellary.	Trichinopoly.

Third Class.

Gopalpore.	Salem.	Secunderabad.
Madras.	Negapatam.	Masulipatam.
Madura.	Cochin.	Kurnool.
Coimbatore.	Mangalore.	Mercara.
Wellington.	Bangalore.	

Vizagapatam is a private observatory, established by Mr. A. V. Nursingrow, who communicates its very excellent registers, as well as a daily telegram, to this office. The others, except Gopalpore, which is administered by the Bengal Office, are under the Meteorological Superintendent of the Government of Madras, whose Report on the Administration has not been received.

As far as can be judged, the work of the observatories has generally been satisfactory, but the communication of the work to this office is very greatly in arrear.

OBSERVATORIES IN BRITISH BURMA.—There are, as in previous years, eight observatories in this province—one, Akyab, under the direction of the Meteorological Reporter to the Government of Bengal; another, Diamond Island, which was established specially for storm-warning purposes, under the Central Office; and six under the immediate direction of the Sanitary Commissioner of British Burma. The total list is as follows:—

Second Class.

Rangoon.

Third Class.

Bassein.	Thyetmio.	Tounghoo.
Diamond Island.	Mergui.	Moulmein.
Akyab.		

Lists of the Superintendents and observers are given in Appendices A, E, and G.

I have received no special report from the Sanitary Commissioner, on the condition of the six observatories under his administration. Rangoon is the least satisfactory of all the second class stations, almost every register received being full of errors, and it contributes less work than any other.

Bassein is another station that has been most unsatisfactory. As long as Dr. Baker was Superintendent, this observatory was one of the best in the province, and a special allowance was granted to the observer. But since his departure, the registers have greatly deteriorated, and towards the end of the year the special allowance was withdrawn. Since then, the observer has left.

The work of Tounghoo and Thyetmio has also been the subject of repeated complaint, and the only observatories under the Sanitary Commissioner that have fairly worked well, are those of Moulmein and Mergui. That of Diamond Island, where the Telegraph Master is observer, has been satisfactory, as far as can be judged from the registers; but that of Akyab is reported by Mr. Eliot to have been in a somewhat unsatisfactory condition during the past year, and to contrast most unfavourably with Cuttack, Dacca and Saugor Island, at which, as at Akyab, the Telegraph Master is the observer.

The only observer in the province to whom a special allowance has been allotted for the current year is—

Name.	Station.	Amount.
		Rs.
P. H. Hilbert	Moulmein	5

OBSERVATORIES AT THE BAY ISLANDS.—These as in former years are two, *viz.*:—

Third Class.

Port Blair (Andamans). | Nancowry (Nicobars).

The names of the Superintendents and observers are given in Appendix E.

The Port Blair Observatory; a very important one, in virtue of its position, has continued to furnish very good work. That of Nancowry has been less satisfactory, the registers having been returned on several occasions for the correction of errors.

The special allowance, awarded last year, to the Port Blair observer has been renewed for the present year:—

Name.	Station.	Amount.
		Rs.
J. F. Peters	Port Blair	5

EXTRA INDIAN OBSERVATORIES.—The list of extra Indian observatories comprises one less than that given in last year's report, owing to the withdrawal of the British Resident's establishment (and therewith the observatory) from Gilgit. And, on the other hand, the two observatories that have been established during the year at Kailang in Lahoul, and in the Seychelles, did not contribute registers during the year under report. The former of these is, however, more properly a Punjab observatory, and will be so classed in future reports. The list for the past year then stands as follows:—

Second Class.

Leh. | Aden. | Zanzibar.

Third Class.

Bushire.	Katmandu.
Quetta.	Amini Divi.

Leh transmits its registers to the Punjab Reporter; Zanzibar to the Reporter for Western India; and the remainder, excepting Amini Divi, to the Central Office in Calcutta. The registers of Amini Divi have been sent to the Madras Office, from which, as yet, I have been unable to obtain them, so that they do not appear in the annual reports of the Department. The names of the Superintendents and observers are given in Appendices C II, E and F II.

In addition to the above, reports are received from the observatory at Goa, which is superintended by Señor Antonio Martins. This has been visited, during the year, by Mr. Pearson, the Officiating Reporter for Western India, and some notice of it will be found in his Report, Appendix F.

The work of the Leh Observatory has been as satisfactory as in former years, and that of the Aden Observatory has shown but few errors. That of Zanzibar has suffered a partial interruption, owing to the observer having been committed to jail; but the continuity of the most important part of the registers was preserved by the exertions of the Superintendent, Dr. Bartholomeux, who, himself, registered the more important instruments during the sequestration of his subordinate.

The registers of Bushire have preserved their usual excellence, and those of Quetta have shown much improvement. But the observatory at Katmandu has been less satisfactory, the barometric registers from August to December having shown an amount of discrepancy, which renders them useless.

The registers of rainfall statistics and marine meteorology have been already noticed in the introductory portion of this report.

INSTRUMENTS.

In Appendix H, is given a return of the instruments in store at the beginning of the year, and of those received and issued by the Calcutta Meteorological Office. This list

includes the stock receipts and issues of the Alipore Observatory; and, in Appendix I, a return of the instruments issued to each observatory.

METEOROLOGICAL OFFICERS AND OFFICE WORK.

The general control of the meteorological observatories and offices in the different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the year :—

Province.	Superintending Officers.	Names.
Bengal and Assam	Meteoro ogical Reporter, Government of Bengal	John Eliot, M.A.
North-Western Provinces and Oudh	Meteorological Reporter, North-Western Provinces and Oudh	S. A. Hill, B.Sc.
Punjab	Meteorological Reporter, Punjab	Surgeon E. Lawrie, M.D.
Central Provinces	Sanitary Commissioner	Deputy Surgeon General B. Simpson, M.D.
	Meteorological Reporter, Government of India	H. F. Blanford, F.R.S.
Berar	Sanitary Commissioner	Dr. Little.
	Meteorological Reporter, Western India	F. Chambers. / Surgeon W. Nolan, M.D. / A. N. Pearson.
Central India and Rajputana	Meteorological Reporter, North-Western Provinces and Oudh	S. A. Hill, B.Sc.
	Meteorological Reporter, Western India	F. Chambers. / Surgeon W. Nolan, M.D. / A. N. Pearson.
	Meteorological Reporter, Government of India	H. F. Blanford.
Bombay	Meteorological Reporter, Western India	F. Chambers. / Surgeon W. Nolan, M.D. / A. N. Pearson.
Madras	Meteorological Superintendent, Madras	Miss Isis Pogson.
Burma	Meteorological Reporter, Government of Bengal	John Eliot, M.A.
	Sanitary Commissioner	Dr. D. Sinclair, M.D.
	Meteorological Reporter, Government of India	H. F. Blanford.
Bay Islands	Senior Medical Officer, Port Blair	Surgeon J. Reid, M.B.
	Meteorological Reporter, Government of India	H. F. Blanford.
Extra Indian Observatories	Meteorological Reporter, Punjab	Surgeon E. Lawrie, M.D.
	Meteorological Reporter, Government of India	H. F. Blanford.
	Meteorological Reporter, Western India	F. Chambers. / Surgeon W. Nolan, M.D. / A. N. Pearson.
	Meteorological Superintendent, Madras	Miss Isis Pogson.

Mr. F. Chambers was absent on sick leave from the 6th June 1882, from which date to the 17th July, Surgeon-Major W. Nolan held charge of the appointment. During the

remainder of the year Mr. A. N. Pearson officiated as Meteorological Reporter for Western India, and has performed its duties in a very satisfactory manner.

In the other provinces, the permanent incumbents have remained in charge of their respective offices.

The following table shows the number of stations, the registers of which were sent to each of the Reporters respectively, for reduction and verification, during the year under report :—

PROVINCES.	METEOROLOGICAL REPORTERS.						TOTAL.
	India.	Bengal.	North-Western Provinces and Oudh.	Punjab.	Western India.	Madras.	
Bengal and Assam	3	20	...	...	...	...	23
North-Western Provinces and Oudh	1	...	15	...	...	...	16
Punjab	...	...	...	11	...	...	11
Rajputana and Central India	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay	...	...	...	...	14	...	14
Madras, Mysore, and Coorg	1	1	...	...	...	15	17
Burma	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	5	...	...	1	1	1	8
TOTAL	32	22	19	12	23	16	124

This list does not include the registers of the Colaba observatory, of Goa and Jeypore, which are furnished to the Meteorological Office with all the necessary reductions.

In Bengal and the North-Western Provinces, the Meteorological Reporters superintend also the numerous rainfall registers of the district and sub-divisional stations of their respective provinces, and prepare weekly or monthly returns of the rainfall; and in Bengal and Bombay, the Reporters have also charge of a system of daily reports, received by telegraph; in the case of the former, (up to the end of the year under report) from fifteen, in that of the latter from ten stations. The Meteorological Reporter for Bengal also administers the newly established department of the Central Office, for the purpose of collecting cotemporary records of the meteorology of Indian seas.

The staff of gazetted officers has been increased, during the past year, by the appointment of Mr. W. L. Dallas, as Scientific Assistant to the Meteorological Reporter to the Government of India. The special duties, for which Mr. Dallas has been appointed, are the preparation of the daily reports, and also of bi-monthly and half-yearly reports on the weather; in general terms, to extend and improve the circulation of current information on the weather, and also the reduction and discussion of the meteorological data for Indian seas, which have been received from the Marine Department of the London Meteorological Office. Mr. Dallas has been for ten years on the staff of the London Office, and has a familiar acquaintance with the work of preparing daily weather reports, according to the system there practised; and before leaving for India, he was placed on special duty for two months, in order to acquaint himself with the work of the Marine Department of that office. He arrived in India, therefore, already furnished with the practical knowledge necessary to enable him at once to assume charge of his duties, requiring only such occasional assistance and guidance as might be necessitated by the change of local conditions, and by his having to deal with a system of tropical meteorology. This additional knowledge

he is now rapidly acquiring, and I have every reason to be satisfied with the aptitude and intelligence he has displayed, in adapting himself to the requirements of his present office.

OFFICE ESTABLISHMENTS.—The following is a return of the number of permanent employés in the offices of the several Meteorological Reporters, as far as information has been received up to the end of the year under report:—

	India.	Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	TOTAL.
Head clerks	1	1	1	1	1	1	6
Computers	3	...	4	1	6	2	40
Clerks and copyists	3	2					
Tabulators	16[1]	3					
Draftsmen	3	...	..	...	...	...	3
Artisans	...	3	...	...	...	...	3
Peons and menials	10	4	1	1	1	1	18

During the past year, the office of the Meteorological Reporter for India has been under the management of the Head clerk, Babu Fanindra Mohun Basu, and with the same very satisfactory results as in former years. Since he has been relieved of the double duty of superintending both the offices for India and Bengal, he has, I am glad to say, enjoyed better health, and has not been obliged to absent himself for any prolonged period from his office duties.

Two clerks and a draftsman were added to my office at the beginning of the year, for the purpose of dealing with the meteorological logs from the Bay of Bengal, of which Mr. Eliot has undertaken the collection, and this portion of the establishment is under his control.

In February, a further addition to the office of a temporary establishment of four tabulators was made, for the special purpose of the reduction of the marine data of past years. This portion of the establishment is under the immediate direction of Mr. Dallas.

Some additions have been sanctioned to the office establishments of the Reporters for the North-Western Provinces, the Punjab, and Madras, but these did not take effect until after the close of the year.

WEATHER BULLETINS AND STORM SIGNAL SERVICE.—The daily weather bulletins were issued at Simla from the 16th May 1882 to the 15th October, and at Calcutta during the remainder of the year. The verbal remarks which, in previous years, have formed part of the report only in the Simla issue, continued to appear during the last year, after the place of publication was transferred to Calcutta, and will henceforth invariably accompany the tabular matter. A telegraphic abstract of these remarks is forwarded daily to the Governments of Bengal, North-Western Provinces and Oudh, Bombay, Madras, Assam, Central Provinces, and British Burma; the Meteorological Reporters of Bengal, North-Western Provinces and Oudh, and Western India; the Director of Agriculture and Commerce, North-Western Provinces; the Port Officer of Madras, and the Government Astronomer of Madras.

A summary of the weather characteristics of the monsoon season of 1882 (May to October) was drawn up by Mr. Dallas, and published in the *Gazette of India* on the 13th

[1] Besides these there are four temporary clerks for reducing Meteorological Office Marine logs.

January 1883, and that of six months, November 1882 to April 1883, was issued in the Gazette for the 2nd June 1883.

The improvements, introduced by Mr. Eliot, in the working of the storm signals of Calcutta and in the daily weather reports issued by his office, have already been noticed in the first part of this report, and further details will be found in the Administration Report for Bengal (Appendix A).

The subject of the storm-warning service in Bombay has also been noticed in the introductory portion of the report, and the subject is noticed at length in Mr. Pearson's Report (Appendix F). No daily reports are published by the Bombay Office.

ANNUAL REPORTS.—The Report on the Meteorology of the year 1881 was completed and in the printer's hands before the end of December 1882, and it was submitted to Government in its complete form on the 18th June 1883. The printing of the text had been completed about two months earlier, but the issue was somewhat delayed by the plates being somewhat behind hand. Arrangements will be made this year to endeavour to effect an earlier issue.

The report gives tables of temperature for 131 stations and rainfall returns for 417 stations, being an increase of five of the former and eighteen of the latter, on the numbers respectively summarised in the corresponding tables of the report for 1880. The returns of pressure, wind direction, and other meteorological elements are nearly as numerous as those of temperature; and registers of the temperature of the ground are given for four stations, against two in 1880. The elements tabulated in the Appendices are as follow. I give for comparison the number of registers summarised in the corresponding tables of the report of the four previous years :—

	Number of stations.				
	1877.	1878.	1879.	1880.	1881.
Equilibrium temperatures of solar radiation	95	99	106	109	106
Temperature of nocturnal radiation	95	97	100	108	106
Temperature of the ground	...	...	...	2	4
Mean and extreme air temperatures	108	116	123	126	131
Sea-level equivalents of mean temperature	94	100	101	105	108
Means and extremes of atmospheric pressure	106	113	119	122	125
Sea-level equivalents of mean atmospheric pressure	93	96	98	105	107
Direction and movement of winds	109	113	118	124	127
Temperature of evaporation	99	106	111	115	121
Tension of atmospheric vapour	106	113	120	123	128
Mean relative humidity	106	114	120	123	128
Mean proportion of clouded sky	104	110	118	122	125
Inches of rainfall in each month	311	353	365	399	417
Number of days on which rainfall was measured	239	276	365	379	403

The descriptive letter-press discusses the meteorology of the year in detail. It includes 29 numbered tables, giving the average values of all the more important elements, for all stations that have forwarded returns for three years and upwards; and the report is illustrated with nine plates; one of which is a chart showing the positions of all observatories and raingauge stations; three, in coloured lithography, represent the distribution of temperature, pressure and winds in each month of the year; and the remainder illustrate particular phases of the weather, *viz.*, the conditions which precede and accompany the rainfall of the cold weather and early spring; the setting in of the monsoon rains in Bengal; the formation of the Kathiawar cyclone, that of barometric depressions on the Gangetic plain; and the Madras cyclone of November 1881.

The original observations at six stations in India, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras, were issued in monthly parts as a distinct publication and form a small quarto volume, the third of the series, prefaced by a detailed description of the stations and the instruments employed. The final sheets of the registers for 1881 were issued in November 1882.

Mr. Hill has also published, independently, a summary of the observations of the observatories which he superintends, and the registers of which are verified and reduced in his office, and Mr. Pearson, the Officiating Reporter for Western India, prepared for the Bombay Government a sketch of the meteorology of the Bombay Presidency in 1881, which was printed in pamphlet form.

Miscellaneous publications.—The first edition of the *Instructions to Observers,* forming the first part of the *Indian Meteorologist's Vade Mecum*, having been exhausted, a new and revised edition was prepared and printed during the past year. This work, being the official guide for Superintendents and observers, is more or less in constant demand for the use of the Department.

One part of the Indian Meteorological Memoirs has been issued during the year, forming the first part of volume II. It contains a memoir, by Mr. J. Eliot, on a cyclone in the Bay of Bengal in September 1878, and a list of the recorded cyclonic storms on the coasts of Bombay and the Arabian Sea by Mr. F. Chambers. Both these have been noticed in the introductory portion of this report. Part II, containing papers by myself and Mr. S. A. Hill, is in the press and will be issued in the course of a few weeks.

Mr. Eliot has in hand a discussion of the storm, that occurred in October 1882, in the Bay of Bengal, and although not severe, brought very heavy rain to the greater part of Bengal; also a discussion of all the storms which occurred in the Bay of Bengal during the period 1875 to 1880, of which records exist in the office. Mr. Pearson has written a paper entitled "A contribution to the study of the transmission eastwards round the globe of barometric abnormal variations," and has tabulated for discussion the data of a number of ships' logs relating to storms on the Arabian Sea.

Some other work in hand, including the rainfall chart of India, the reduction and discussion of the marine logs relating to Indian seas, &c., have been noticed at length in the introduction.

A comparative return of the rainfall of India, in 1882, with illustrative charts, was prepared and submitted to Government for communication to the Secretary of State on the 30th March 1883.

Appendix K gives a list of the Government officials, offices, libraries, societies, &c., to which the publications of the office are presented, including those which furnish their own publications in exchange.

LIBRARY.

The library is contained in six large double book-cases and is in excellent condition. An alphabetical catalogue of the bound volumes has been made by Mr. Dallas. The list of additions to the library during the past year is given in Appendix L.

HENRY F. BLANFORD,
Meteorological Reporter to the Government of India.

SIMLA:
The 2nd August 1883.

APPENDIX A.

Extracts from the Administration Report of the Meteorologicl Reporter to the Government of Bengal for the year 1882-83.

DURING the official year, 1882-83, meteorological observations were taken regularly at one first class observatory, seven second class observatories, and twelve third class observatories in the provinces of Bengal and Assam. An additional third class observatory was established at Tura in the Garo Hills in the month of March 1883.

During the year, a series of changes was sanctioned by the Bengal and India Governments for extending the work of observation of the Department, and for improving the publication of the meteorological data collected by the Department for the information of the Government of Bengal, district officers, and the general public. As these changes very considerably extend and modify the Department under my charge, it appears desirable to place on record a full statement of the reasons for the changes, and an account of the circumstances under which they were made.

The origin of the proposals was a demi-official letter which I received from the Secretary to the Government of Bengal, Revenue Department, Mr. A. P. MacDonnell, on the 11th of August. In this, he pointed out that the meteorological information published in the Gazette was not sufficient for the wants of the Bengal Secretariat, and asked if I could not arrange to publish weekly in the Gazette the meteorological observations taken over the province during the preceding week, together with a statement in which the more important meteorological features of the week should be clearly and prominently brought to the notice of Government and district officials. The attention of the Government of Bengal was particularly directed to the meteorology of Bengal and the working of the Bengal Meteorological Department at this time, by the unusual lightness of the rains in Northern and North-Eastern Bengal. It was so serious, at one time, as to suggest the probability of a partial failure of the crops. The daily reports, issued by the Meteorological Reporter to the Government of India, gave very little information respecting this part of Bengal, and threw no light on the meteorological conditions of the district. The returns, sent in to me by post, and tabulated in the ordinary routine of the work of a small office, did not show until later that, although the rainfall was deficient and abnormal in character, this was due mainly to lightness of the rain showers and not to any diminution in the number of rainy days or in the amount of cloud. I replied to Mr. Secretary MacDonnell's letter on the 13th of August, admitting that the Bengal Meteorological Department was, in comparison with similar Meteorological Departments in European countries and the United States, very much behind hand in utilising and publishing for the public benefit the meteorological data it collected. I pointed out that this part of the work of the Department, "Economic Meteorology" as it might be termed, appeared to me to be of primary importance in India, and added that I should be willing, if the means were placed at my disposal, to use my utmost efforts to propose and establish an effective provincial meteorological system, which should collect, tabulate, and publish, at frequent intervals, the results of the observations taken throughout the province, at a sufficient number of stations, to represent its more important meteorological conditions and changes adequately, together with a comparison of the current atmospheric conditions in Bengal, with the normal meteorological conditions of the province; and to trace out, so far as I could, the connection between these variations in the elements of meteorological observation, with the variations in the distribution of rainfall throughout the year. I also indicated, roughly, the more important changes it would be necessary to make, in order to establish and develope a provincial system of meteorological observation, which should keep the Government fully informed of the present meteorological conditions of the province and their variations from the normal conditions. Mr. Secretary MacDonnell replied demi-officially to this on the 29th of October, stating that I had correctly estimated and described what was

required to improve the meteorological information supplied by my Department, and that the Lieutenant-Governor approved the objects aimed at, and the general outline of the proposals I had suggested to secure these objects, and requested me to come up to Government officially on the matter, and submit my proposals with the necessary fulness, and to state the modification it would be necessary to introduce into the existing establishment and practice of the Department.

I spent a part of the college cold-weather vacation in collecting information, and finally submitted my proposals to the Government of Bengal on the 29th of December. The following extracts (with some slight modifications and change of verbal expression) will indicate the objects aimed at, and the character of the proposals :—

"The Meteorological Departments in India ought to carry out two objects differing considerably in character and value. The first is that of contributing a share towards the advancement of meteorology as a science, *i.e.*, of the determination of the exact relations which subsist between the various atmospheric conditions and changes and the effective causes or actions. India is the only tropical country which possesses a fairly complete and satisfactory meteorological system for this purpose. It also presents, from its geographical position, many unique meteorological conditions and features of great scientific interest and value. It is thus qualified to play a very important part in the progress of scientific meteorology. This it can do, by collecting and publishing accurate observations, taken under suitable conditions, and also by discussing them in a scientific manner, and distributing the results of its investigations to meteorologists over the world. This appears to me to be the work to which the Meteorological Reporter to the Government of India and his Scientific Assistant (lately appointed) are mainly devoting themselves, and to which they make the local reporters subservient. It is evident that it is immaterial whether the relations they are in search of are determined from observations of a day or a century ago, provided they are known to be accurate and reliable, and the investigations are exact. Rapidity in the collection and discussion of the observations is obviously not desirable, and might be dangerous, as leading to hasty and perhaps erroneous conclusions.

"The second object of the Meteorological Department is less important from a scientific aspect, but is of supreme importance economically in a country like India, which is dependent for its prosperity almost entirely upon its agricultural resources and productions; and where the fluctuations of rainfall are so great, as to subject a large part of the country to the occasional occurrence of prolonged drought and intense famine." This second branch of meteorological work in India is to publish, for the information of the Government, and all others directly interested in it, frequent statements of the present meteorological conditions of the country and its variation from the average conditions, and, so far as is possible, anticipations of any impending important atmospheric disturbance. This it can only do by the rapid and continuous collection, tabulation, and discussion of the observations taken at the various reporting stations. This continuous consideration of the weather, as it is at the present moment, will alone furnish the experience, methods and instincts necessary to consider it as the invariable antecedent of the weather to come. This will gradually lead up, in the case of Indian meteorological enquiry, to the true test and the ultimate aim of every science—prevision more or less perfect. An early step in such a direction, for example, would be to previse the general character of the distribution of the monsoon rains, from the atmospheric conditions of the preceding hot-weather months. This, which may be termed "economic meteorology" in opposition to the first or "scientific meteorology," is of as great importance to the Local Governments as to the Imperial Government. It is included in the programme of the Meteorological Reporter to the Government of India. The publication of his daily weather report supplies sufficient information to satisfy the present requirements of the Government of India. But this report is published at too frequent intervals for the guidance of officials in Bengal, the remarks are very brief and general, and are especially defective in the most important point, *viz.*, the distribution of rainfall in each province, more especially during the south-west monsoon, and are practically of no great value for the information and guidance of the Government of Bengal. This branch of meteorological work in India was the subject of special recommend-

ation by the Famine Commissioners, as is shown by the following quotation (*vide* Report, Part I, paragraph 40) :—

" 'Within the last few years a very satisfactory system of meteorological observations has been established all over British India, and in our opinion it is of primary importance that it shall be maintained in complete efficiency, and shall so far be strengthened and improved, as to ensure the early and puuctual supply of information to the Executive Governments, and to the officials in all departments concerned with the agriculture of the country, or the preparations required to meet famines, as to the actual progress of the periodical seasons of rain in all parts of the provinces, for which those Governments or officers are respectively responsible. So far as it may become possible, with the advance of knowledge, to form a forecast of the future, such aids should be made use of, though with due caution.'

" This early and punctual supply of meteorological information is moreover, as General Strachey pointed out to me a few years ago, that part of meteorological work which the Local Governments ought not merely to encourage, but to promote, and which is more especially the province of the Local Reporters as opposed to the Imperial Reporter.

" The work proposed to me to carry out is identical in its general character with that stated by the Famine Commissioners to be one of the most important duties of the Meteorological Department, *viz.*, the early and punctual supply of accurate meteorological information to the Executive Government and district and other officials. The extensions that I desire to submit to the Government of Bengal, have this solely for their object. They provide for the daily submission of observations, taken at 10 A.M., at 38 stations, distributed throughout the province, and of rainfall returns from about 156 additional stations, and for their rapid continuous reduction, tabulation, and discussion in the Bengal Meteorological Office. The complete rainfall returns of the province, I propose, shall in future be considered at the same time and in conjunction with the meteorological observations. This will be effected, by linking to each meteorological observatory, the adjacent rainfall recording stations. By this mode of treatment, I hope to determine all the more important meteorological features of each district, which will thus be represented by a group of one or two observing stations and several rainfall stations. In this way, more especially, the amount, distribution, and variation from the mean, of the rainfall throughout the province, can be approximately gauged week by week, month by month, or season by season, and be recorded in the speediest and most exact manner for the information of Government.

" The present meteorological system, established in Bengal, appears, with the above objects in view, to be defective in the following respects :—

" *1st.*—The stations are too few in number to represent adequately the province of Bengal. They are, in all, fourteen stations for the whole of Bengal, Behar, Chutia Nagpore, and Orissa, including an area of 205,000 square miles. Of these stations, two—False Point and Saugor Island, on the seaboard—are maintained solely in connection with the Calcutta Storm Signal Service. The province of Bengal, occupying an area nearly twice as large as the British Islands, is represented meteorologically, for agricultural and economic purposes, by only twelve stations. The weekly agricultural and weather report of the British Islands, published by the English Meteorological Office, is based on the meteorological returns of 66 stations, and I am informed that even that number of stations is considered insufficient. In making this comparison, I do not wish to assert that observing stations should be as thickly spread in India, as in England, to give the same extent of information of weather conditions and changes. The weather in Bengal is undoubtedly much more uniform than in the British Islands. Irregularities of atmospheric conditions are also usually of a much simpler and more persistent character. Even taking these facts into consideration, it appears to me that Bengal is by no means sufficiently represented by its present twelve meteorological stations.

" *2nd.*—The present observatories are by no means equally distributed throughout the province. Large and important districts, from an agricultural point of view, are almost, if not entirely, unrepresented. The most glaring example of this is Northern Bengal. The whole of the Bengal plains to the east of Purneah, and to the north of Berhampore, Jessore, and Dacca, comprising, I

believe, the entire jute-producing districts of India, does not possess a single observatory. The more eastern districts are to a certain extent represented by Dhubri and Silchar. It appears, however, not too much to assert that Northern Bengal as a whole is unrepresented in our meteorological system at the present time. Similarly, the whole of the southern districts of Chutia Nagpore, and the Midnapore and Balasore districts, are outside the range of observation of the existing stations.

"*3rd.*—The present system of twelve stations, which, even if it were in perfect order, would be insufficient to represent Bengal, is really, in consequence of a third defect, less efficient than it appears. Native observers, in consequence of their imperfect scientific instincts, and of the very slight scientific training given in Indian schools and colleges, are frequently inaccurate. And even if they have been carefully trained, many of them are liable to lapse into careless and erroneous methods. Frequent inspection at unexpected times, and more especially when the returns themselves indicate errors, more or less continuous, is an absolute necessity. Yet this, under the present system, is an impossibility in Bengal. I am bound down to Calcutta without a day's intermission for practically ten months of the year, by the combination of my college duties, my storm signal and daily weather report work, and by the charge of the India Weather Office during the absence of the Reporter to the Government of India in Simla. I can only leave Calcutta, on inspection duty, for a short period during the cold season. Defects, observational or instrumental, may hence be prolonged for months, and even years, without detection. This defect is a very serious one. Each succeeding year's tour of inspection impresses it upon me more strongly.

"*4th.*—The present mode of collecting, reducing, and discussing the meteorological observations is dilatory and unsatisfactory. If the sole object of the Department were the collection and publication of accurate observations for the information of European Meteorologists, it would be unobjectionable. As pointed out by the Famine Commissioners, early and exact meteorological information is at all times valuable to the Government and district officers of Bengal, and occasionally it is a pressing necessity; and yet it is hardly too much to state that the Bengal Reporter can furnish to the Provincial Government fuller and later information of the meteorology of any portion of the British Islands than he can of the greater part of Bengal. It is not necessary to state fully the causes of this. It is sufficient to state that the present system has tended to centralization rather than to development: hence it is the Government of India that has mainly profited by the recent changes. The Provincial Government of Bengal is not as yet furnished with the early and punctual supply of meteorological information which it requires.

"The proposals aim at the removal of the defects enumerated in the preceding paragraphs, and at the carrying out of the object proposed :—

"*1st*—By the establishment of additional observatories.

"*2nd*—By the extension of the work of inspection.

"*3rd*—By the increase of my office establishment.

"*4th*—By frequent publication of returns.

"I propose, in future meteorological reports and discussions, to divide Bengal into seven areas, each of which will be a fairly homogeneous area, and differ from the others in its meteorological features, more especially the amount and distribution of its rainfall. Each of these areas will be represented by three to seven observing stations, giving all the meteorological features, except rainfall, with sufficient fulness for present purposes. The rainfall will be determined by these observing stations and the 156 additional rainfall recording stations, three to five of which will be linked to each observing station, so as to enable the rainfall of the district, represented meteorologically by the observing station, to be approximately determined.

"The seven meteorological areas I propose are—

"*1st*—Orissa.

"*2nd*—South-West Bengal, including the Burdwan and Presidency Divisions.

"*3rd*—East Bengal, including the Dacca and Chittagong Divisions.

"*4th*—North Bengal, including the Rajshahye and Cooch Behar Divisions.

"*5th*—North Behar, including the districts of Behar north of the Ganges.

"*6th*—South Behar, including the districts of Behar south of the Ganges.

"*7th*—Chutia Nagpore.

"In order to assign an adequate number of observing stations, it will be necessary to increase the present number very considerably. This I propose to effect through the agency of the Public Works Department, which has been most freely offered for the extension. I am informed by Major Neill, Assistant Secretary, Public Works Department, that observations are taken at Buxar, Arrah, and Dehree, and that they could be taken at a large number of stations by overseers. These men are specially qualified, by their training in surveying, to read such instruments as the barometer, and would make valuable observers.

"The following are the stations, which I have selected from the list given me by Major Neill, where observatories could be established and the work of observation properly carried on, through the agency of the Public Works Department :—

Motihari.	Dinagepore.
Ranchi.	Serajgunge.
Chyebassa.	Mymensingh.
Balasore.	Furreedpore.
Midnapore.	Commillah.
Raneegunge.	Noakhally.
Nya Doomka.	Burrisal.
Bhagulpore.	Rampore Baulia.
Julpigori.	Chupra.
Rungpore.	

"These, with the two stations of Buxar and Dehree, would give 21 additional observatories. This extension will necessitate the immediate erection of 19 observing sheds.

"The Public Works Department, in making the offer of the services of these overseers as observers, did not contemplate that they should receive any remuneration, and I am not therefore prepared to urge upon Government its absolute necessity. On the other hand, a small monthly allowance will not only give them a tangible interest in their meteorological work, but also furnish me with some hold upon them, for the proper performance of their meteorological duties. There would thus be a reasonable probability of the additional observations being fairly trustworthy and accurate, and equal in value to those taken at our present observatories. My past experience shows that this would almost certainly not be the case if this additional work (not a part of their recognised duties) were imposed upon them without any remuneration. The monthly allowances would be granted, conditional upon the punctual and accurate performance of their meteorological duties during the month, as tested by the returns received from them in my office. As the work would be less than at our present third class observing stations, I would suggest that these fourth class observers be granted allowances of ten rupees monthly. This will necessitate a yearly grant of Rs. 2,520. If these proposals be sanctioned, they will, I believe, give the Department the increased power of observation, which appears to me necessary, in the most effective and economical manner possible, and will remove almost entirely the first and second defects of the present system.

"As my meteorological duties are increasing year by year, I am unable to suggest any feasible plan which will enable me to inspect the observatories at any time throughout the year, whenever it may appear desirable or necessary. I would therefore suggest the appointment of a native inspector on Rs. 50 rising to Rs. 60 per mensem. It will be possible, for this amount, to obtain the services of a man who has been trained at the Seebpore or Roorkee Engineering College in the use of instruments, and has learnt to draw and chart neatly. He would supply a double want in the Bengal Office. Whenever the returns received indicated continued instrumental or observational defects at any station, he would be sent there to ascertain the causes of the errors, and thus enable me to remove them without unnecessary delay. When in Calcutta, he would be employed in preparing the various charts that will be required to enable me to prepare the weekly reports. He would also be very useful, during the first year of the extension, in teaching the new observers of the Public Works Department their meteorological duties. As I do not propose to diminish my own work of

inspection during the cold weather, which I consider indispensably necessary to the maintenance of the stations in a state of efficiency, it will also be necessary to provide for the travelling expenses of the native Inspector. These, I estimate, will not exceed Rs. 400, which I would therefore ask Government to sanction in addition to his pay."

I have already stated that, in future, it appears to me desirable the rainfall returns should be considered and discussed in connection with the meteorological observations. The first essential for early publication of meteorological results is rapid transmission of the observations to the central office. Hence, in all cases where it is possible, the 10 A.M. meteorological observations will be despatched to Calcutta by weather telegrams. At those observing stations where there is no telegraph office, the 10 A.M. observations, taken daily, will be sent by the first dâk after each observation to Calcutta, by means of postal cards. The observations will be reduced and tabulated in my office as they arrive. Of the 38 stations under the extended scheme, 29 can communicate by telegraph at the present time; and with the probable early extension of rail and telegraphic communication to Jessore, Burrisal, Mymensing, and Chutia Nagpore, the number will increase, so that, in a few years, a fairly complete daily weather report for the whole province may be prepared from the weather telegrams. The majority of the stations which can communicate with the central office by post only, are in Eastern Bengal; and hence the information of that part of the province will be for some time more imperfect and behind hand than for the remainder of this province.

All rainfall-reporting stations will send in a daily return of rainfall, by means of postal cards. They will also, in all cases, submit a weekly rainfall report by post-card, as a check on the daily returns, in which mistakes from carelessness or haste may occasionally arise, or which may, in a few cases, be lost in postal transmission.

Those sub-divisional stations, which are at a greater distance than 48 hours dâk from Calcutta, will telegraph either directly or from the nearest telegraphic station, (for which special arrangements in each case will be made), with the object of completing the daily returns included in the weekly rainfall report to be published in future in the Gazette.

It will therefore be seen that I propose to receive the various returns, in all cases, direct from the observing officers, and not, as at present, in the case of rainfall returns, through the medium of a superior officer, as, for example, the Collector, the Civil Surgeon, &c. The delays in the submission of the rainfall returns under the present system, are in some cases excessive, and are due to the transmission from the recording officers, through other officials, not directly interested in the rapid collection of the information. Of course, if it be desired, there is no reason why the Collectors, Civil Surgeons, &c., should not receive a copy of the rainfall returns sent in direct to me. If this part of the scheme be adopted—and it is the only means I can suggest for effecting the continuous rapid transmission of the necessary returns to my office—it would be very desirable that the Government of Bengal should issue a circular to the sub-divisional and other rainfall-recording officers, requesting them to carry out fully and exactly the instructions I shall issue for the transmission of their rainfall returns, and if judged desirable and unobjectionable, permiting me to place myself in direct communication with them in order to call attention to probable errors of observations or delays in transmission.

From the 15th of May to the 15th of November, a period which includes the whole of the south-west monsoon rain in Bengal, it is proposed to publish a daily weather report containing the observations taken at 10 A.M. and transmitted by ordinary or urgent weather telegram to Calcutta, together with a short summary of the more prominent features of the weather, its deviation from the normal weather of that day by a comparison with the average pressure and temperature of the day, and the important changes of the previous 24 hours, with, bye-and-bye, anticipations of the weather throughout the province during the next 24 hours. This will be printed at the Secretariat Press by 6 P.M. each day, and sent by post to Government officers, district officers, and to certain officers of the Public Works Department. It is also proposed to publish, weekly, in the Gazette, two meteorological returns. The first will give the averages or totals of the elements of meteorological observation at the 38 reporting stations, and the average rainfall of the districts, represented meteorologically by each

station, together with the variations of the pressure, temperature, and rainfall from the means for the period. The second return will give the daily rainfall at all the sub-divisional stations for the preceding week, and from which the average rainfall of the districts given in the other return will be derived. A summary will also be given, generally similar in character to the weekly agricultural weather report issued by the English Meteorological Office. In this the important features of the weather will be brought to notice, and the distribution of rainfall with respect to time and place, and its variation from the normal rainfall, will be fully worked out.

In addition to this, it is also proposed to publish in the Gazette, for more general reference, the usual monthly averages of the elements of meteorological observation for the 38 observing stations, and the average rainfall of each district for the month, together with a short summary, stating briefly the more marked peculiarities of the meteorology of the month. A return will also be published in the beginning of every month, giving the daily rainfall of the 162 sub-divisional stations for the preceding month. This will be to a large extent a reproduction of the weekly rainfall returns, but it will contain all returns not received in time to be included in the corresponding weekly reports. Also any errors which may be detected, during the month, in the printed weekly rainfall returns will be eliminated, so that the monthly rainfall return will be the final, complete and corrected publication of the rainfall for the period in question.

Forms, embodying these objects, have been drawn up and submitted to the Government of Bengal. They have been accepted after a few modifications, and will be adopted for the present, and until experience of the working of the new scheme shows what improvements it may be desirable to make in them.

The extensions which I proposed supplemented the existing arrangements, and I had consulted with the Meteorological Reporter to the Government of India, who approved generally of the scheme. As the Meteorological Department is on the Imperial Establishment, it was necessary for the Government of Bengal to submit the proposals to the Government of India for sanction, and to indicate the sources from which the additional expenditure was to be met. This was done in Mr. Secretary MacDonnell's letter No. 294—68Mis. (F), dated the 29th January 1883, to the Government of India, Revenue and Agricultural Department, in which he stated that, "finding the present Bengal meteorological reports inadequate for the purpose of administration in this province, the Lieutenant-Governor called on Mr. Eliot to prepare and submit a scheme calculated to afford this Government that detailed information regarding the meteorological conditions of all parts of this province, of which it now feels the want. This scheme Mr. Eliot submits in the papers herewith forwarded, and the Lieutenant-Governor requests that His Excellency the Governor General in Council may be moved to sanction the adoption experimentally of Mr. Eliot's proposals in this presidency. It will be observed that the proposals now submitted are purely supplementary of existing arrangements, (which they in no way modify), and may be at any time annulled without any disturbance of the latter. The entire cost of the improvements will fall on Provincial Revenues. I am to add that any conditions as to control, &c., the Government of India may think it, in the interests of the Imperial Meteorological Department, necessary to impose, will be readily accepted by this Government."

The Government of India replied that it was willing to accept these proposals, and sanctioned the scheme which had been prepared with so much care by the Meteorological Reporter to the Government of Bengal. It was further stated that "such control as may be necessary will, in the interests of the Imperial Meteorological Department, be most conveniently exercised by the Meteorological Reporter to the Government of India. In view of this object, the Government of India considers that the cost of the scheme should be treated as a contribution from Provincial to Imperial funds, and that provision for this additional expenditure should be made in the estimates of the Meteorological Department of the Government of India, with effect from the 1st April 1883. Unless His Honour the Lieutenant-Governor has any objection to urge to this proposal, it will forthwith be carried into effect."

The extensions are now being effected as rapidly as circumstances will permit, and will be fully stated in next year's Administration Report.

Second Class Observatories.—These are seven in number, of which five are situated in Bengal and the remaining two in Assam. The following table gives the names of the Superintendents and observers at these observatories during the past year :—

Stations.	Superintendents.	Superintendent's allowance.	Observers.	Observer's allowance.	Assistant observers.	Assistant observer's allowance.
		Rs.		Rs.		Rs.
Sibsagar	Dr. R. M. Maiklejohn [1]	30	Babu Dandadhor Dutt Barua.* [2]	30	Babu Rateneswar Gogoi.	10
Dhubri	„ J. Mullane	30	Munshi Monirud-din Ahmed.*	30	Munshi Kadim-uddin. [3]	10
					Munshi Kafait Ulla, Offg.	...
Bankipore	„ J. C. Shaw [4] / „ J. G. French [5]	30	Munshi Mohubbut Lal.	30	Munshi Muddun Mohun Lal.	10
Hazaribagh	„ R. Cobb	30	Mahomed Ameer [6] / Nathu Lal [8]	30	Nathu Lal [7]	10
					Dwarkanath [9]	...
Saugor Island	*Nil*	...	Babu Heralal Seal. [10]	45	*Nil.*	...
			Mr. E. R. Swatman [11]		*Nil.*	...
			Babu Heralal Seal. [12]		*Nil.*	...
			Mr. A. J. Moth ..		*Nil.*	...
Cuttack	*Nil*	...	Mr. J. C. Smith†	32	Mr. H. W. Alley [14] / Mr. S. Adams [15] / Mr. H. W. Alley [16]	13
Chittagong	*Nil*	...	„ E. Pereira [17]	32	Mr. J. Dias	13
			„ P. O. Pereira	...		

[1] From 1st April 1882 to 15th September 1882, and from 28th October 1882 to 31st March 1883.
[2] Was in charge of the observatory from 16th September to 27th October 1882.
[3] On leave from 22nd July to 9th September 1882.
[4] 1st April to 1st December 1882.
[5] 2nd December 1882 to 31st March 1883.
[6] 1st April to 27th June 1882, when he was dismissed.
[7] 1st April to 27th June 1882.
[8] 28th June 1882 to 31st March 1883.
[9] Ditto ditto.
[10] 1st April to 18th October 1882.
[11] 19th October to 1st November 1882.
[12] 2nd November 1882 to 20th January 1883.
[13] 21st January to 31st March 1883.
[14] 1st April to 4th July 1882.
[15] 5th to 15th July 1882.
[16] 16th July 1882 to 31st March 1883.
[17] 1st April to 8th November 1882.
[18] 9th November 1882 to 31st March 1883.

* Received special allowance of Rs. 5 per month for good services.
† Received special allowance of Rs. 10 per month for good services.

Five of these observatories are furnished with self-registering anemographs. There were one or two breaks in the working of these instruments during the year, which are detailed in the following table :—

Stations.	Date of commencement of work.	Periods during which instrument was out of order during 1882-83.
Dhubri	18th March 1882	
Hazaribagh	15th April 1880	From 17 hours 30th April to 17 hours 31st May 1882. 17 hours 30th November to 10 hours 15th December 1882.
Chittagong	20th June 1879	1st April to 8th July 1882.
Saugor Island	9th February 1880	9th January to 22nd February 1883.
Cuttack	11th April 1879	

Three of these observatories, *viz.*, Bankipore, Hazaribagh, and Cuttack, were visited during the cold weather.

Hazaribagh was reported on unfavourably last year. This, which was formerly one of the most satisfactory of the Bengal observing stations, had fallen off solely in consequence of the indolence and carelessness of the observer. He was fortunately detected by the Superintendent in recording and sending to the Meteorological Office inaccurate and false statements, and was consequently dismissed from Government employment. The second observer was then appointed first observer, and appears to have done his work satisfactorily throughout the past year. The observatory was inspected on the 8th December 1882. No change has been made in the position of the shed during the past year, 1882-83, or of the instruments since my last visit in December 1881. The shed was clean and in good order. The anemograph tower required some slight repairs to make it water-tight. These have since been made.

The instruments were generally clean and in proper working order. The only instruments which were not perfectly satisfactory were the wet and grass minima thermometers. In both of these, the columns were badly broken. The instruments had, I was informed, given much trouble in this respect for some time previously. They were ordered to be replaced by new instruments. The anemograph was not working when I inspected the observatory, in consequence of the clock requiring cleaning. I found, however, that this instrument had been sadly neglected by the previous observer, and that it had not been in proper working condition for some months in consequence of two defects, both affecting the wind direction. The instrument had evidently not been cleaned or oiled for months. The gearing of the wind vane had consequently become rusted, to such an extent, as to make the vane immoveable under the action of any wind of ordinary strength. The chain connecting it with the recording part of the instrument had also lengthened slightly, and was badly adjusted, and too slack to work properly. These defects were repaired, and the observer taught how to oil it and to take it to pieces. Full instructions were also given to him to oil and clean it at regular intervals. The defective condition of the anemograph was, I found, mainly, if not entirely, due to the neglect and indolence of the previous observer. The observer and assistant observer read the instruments carefully and accurately. The present observer is intelligent, takes much interest in his work, and sends in his returns regularly. Hazaribagh thus promises to regain its former character as an observing station.

The Bankipore observatory was inspected on the 20th and 21st of December. No change has been made in the position of the instruments since Mr. Pedler's visit. The shed is in good order and has been protected by a fence. Strong ladders have been built, to give ready access to the anemometer and wind vane on the roof of the building. The barometer was examined, and a long series of comparisons made by the observer and myself, with two secondary standard barometers. The comparison seemed to indicate that the instrument has a variable index error, and that the amount of its error was, on the average of the observations, made during my visit, somewhat less than that assigned to it by the original comparison at Alipore. It was therefore replaced by one of the standard instruments, and ordered to be returned to Calcutta for a careful examination and re-determination of its index error. All the instruments were, with the exception of the barometer, in good order, and very clean. This observatory has improved very much since Mr. Pedler's visit, and is now in a satisfactory state.

The Cuttack observatory was inspected on the 11th of January. This observatory has been under the charge of Mr. Smith, Telegraph Master, for the past eleven years. I found the observatory in the same thoroughly satisfactory condition as on my last visit two years previously.

The Cuttack, Dhubri and Saugor Island observatories are the best of the second class observatories. I was unable to visit Dhubri during the year, but, judging from the accuracy of the observations and the neatness of the returns, I am confident that it has improved considerably during the past year. The observer has, moreover, on more than one occasion, sent valuable series of observations taken during storms. As he has been observer for many years, and continues to show increasing interest in his work, I have recommended him for the higher personal allowance of

Rs. 10. Sibsagar continues to work satisfactorily. Patna and Hazaribagh have both improved greatly, and may be considered as having regained their former character. The second class observatories are thus generally in a satisfactory condition, and the observers are performing their duties accurately and honestly.

Third class Observatories.—These were thirteen in number at the end of the year. Ten of them are in Bengal, one (Akyab) in Burmah, and two (Silchar and Tura) in Assam. The Tura observatory was established during the year at the suggestion of the Assam Government, and promises to give useful information for the eastern half of the Garo hill district.

Eleven of these are maintained solely by Government, one (Durbhanga) is supported by the Rajah of Durbhanga, and another (Demagiri) is a voluntary observatory established under rules sanctioned by the Government of India.

The following table gives the list of the third class observatories, with the Superintendents and observers of each, during the year 1882-83:—

Third Class Observatories.

Stations.	Superintendents.	Observers.	Observers' allowance.
			Rs.
Darjeeling, St. Paul's School.	R. Carter, Esq., Rector, St. Paul's School	Mr. W. Moore	25
Purneah	Dr. Picachy	Babu Russick Lal Bose [1] „ Rajanikanta Chackravarti [2] „ Russick Lal Bose [3]	15
Durbhanga	„ J. Ffrench-Mullen [4] „ J. C. Shaw [5] Babu Gopal Chundra Bose [6] Dr. W. A. Gilligan [7]	Jogin Chandra Banerji *	...
Gya	„ R. Macleod	„ Nowrangi Lal	15
Berhampur	„ S. M. Shircore	„ Mohendra Nath Roy †	15
Burdwan	„ J. O'Brein [8] „ H. B. Purves [9]	„ Mokhoda Prosad Chowdhury †	15
Jessore	„ D. W. D. Cummins	„ Poresh Nath Chowdhury	15
Dacca	*Nil.*	Mr. E. D. Shave [18] „ J. S. Davis [19]	25 15‡
Silchar	Dr. J. J. Monteith	Babu Romes Chundra Bhadra	15
Demagiri	*Nil.*	„ Nobin Chundra Ghose [10] „ Bhagarath Barmah [11] „ Surjya Kumar Ghose [12]	*Nil.*
False Point	*Nil*	Mr. E. Workman [13]	25
		„ J. M. Bennett [14]	25
Akyab	*Nil*	„ P. G. Pote [15] „ H. J. Smythe [16] „ R. J. Keys [17]	15§ 15 15
Tura	Civil Medical Officer	.....	...

1 1st April to 16th July 1882.
2 17th July to 31st October 1882.
3 1st November 1882 to 31st March 1883.
4 1st April to 13th December 1882.
5 14th December 1882 to 6th March 1883.
6 7th March to 16th March 1883.
7 17th March to 31st March 1883.
8 1st April to 24th October 1882.
9 25th October 1882 to 31st March 1883.
10 1st April to 9th December 1882.
11 10th December 1882 to 11th January 1883.
12 12th January to 31st March 1883.
13 7th August 1882 to 31st March 1883.
14 1st to 3rd April 1882.
15 4th to 18th April 1882, and 4th June to 8th September 1882.
16 9th September 1882 to 15th February 1883, and 22nd February to 31st March 1883.
17 19th May to 3rd June 1882, and 16th February to 21st February 1883.
18 1st April to 28th December 1882.
19 28th December 1882 to 31st March 1883.

* Received special allowance of Rs. 5 per month.
† Ditto ditto „ 10 „
‡ From 28th December 1882.
§ „ 9th September 1882.

I was able to visit the whole of the third class observatories during the college cold-weather vacations, with the exception of Jessore, Silchar, and Akyab. No change was made during the past year in the character of the observations or the condition of the observatories. My opinion of them is unchanged. Some of them are quite equal to the second class observatories as regards the accuracy and value of their observations. In others, occasional carelessness and neglect of the instructions laid down in the *Vade Mecum*, diminish very considerably the value of the observations, and introduce an element of doubt into the results of their work.

The following accounts of the observatories which were visited during the cold weather are taken from my inspection reports:—

"I visited the Darjeeling observatory on the 16th and 17th of November. The shed was in capital condition; the instruments clean and in good order, and properly placed. The Casella's anemograph had been properly placed in position before my visit in November. The shed in which it is placed is on a fine open site on the top of a hill above St. Paul's School. When I was there, the air was perfectly calm, so that I had no opportunity of seeing the instrument working under ordinary conditions. I examined it carefully, and made several changes. It has been working since, and the observer, Mr. Moore, has spent much time, labour, and ingenuity in endeavouring to make it work successfully, but the results are not altogether satisfactory. The traces received lately are sufficiently distinct to enable them to be used for the determination of the elements of wind observation. So far as I can judge, the instrument is not a good one, and I should prefer to see it replaced by a Beckley's anemograph, which gives a continuous record. Experience appears to show that the Beckley's is easier to work and less liable to derangement.

"The Purneah observatory was inspected on the 23rd, 24th, and 25th of December 1882. The shed is on the same site as it occupied on my last visit two years ago. I found that the foundations of a house for the jailor had been laid within a few feet of the observatory, and the building itself would be shortly erected. It was therefore necessary to give orders for the early removal of the observatory. A suitable site was selected, where the conditions of exposure are almost identical with those of the present observatory. The shed itself was in fair order. No repairs had been made for some time in view of its removal to another site. The thermometers were all clean and in good order. The barometer was in the same room as two years ago. As the light in it is bad, I removed the barometer to an adjacent room at the same level, and where it is in good light. The barometer was carefully compared at the dâk bungalow by myself, and its index error was ascertained to be unaltered. The wind vane and anemometer are well placed. They were slightly stiff in consequence of not being oiled frequently enough. The anemometer was carefully oiled and cleaned, and the observer instructed how to keep it in proper condition. He read the anemometer somewhat imperfectly. This was partly due to his having overlooked the instructions in the *Vade Mecum*. He learnt quickly, and I hope the anemometer observations at this station will in future be exact. The observer is intelligent and punctual in his work, in which he appears to take much interest. The observatory, on the whole, is in a satisfactory condition.

"Durbhanga was inspected on the 20th and 21st of December 1882. I arrived at the observatory at 4-7 P.M. by the dispensary clock, and found the observer there. On enquiring about the 4 P.M. observations, I was shown the following entries for that day:—

	10h.	16h.	18h.
Barometer	30·130	29·030	
Attached thermometer	66·5	71	
Dry bulb	67	74	
Wet bulb	62	65	
Dry ,, max.	...	...	74·8
,, min.	54·5	...	
Wet ,,	53·5	...	
Grass ,,	41·5	...	
Sun max.	...	...	118
Anemometer	248·4	265·3	
Wind direction	22	22	

"The observer was then asked to read the barometer, and stated that it was 29·980. I read it myself and found it to be 29·968. The reading entered in the form B, even if corrected to 30·030, was thus erroneous. The observer then endeavoured to excuse himself by asserting that he had been at the Magistrate's court and that an assistant had taken the readings. As it was unnecessary for me to ascertain more than I did (*viz.*, that the observations at Durbhanga on this day, and probably, as indicated by the returns, for some time previous, had been taken in an exceedingly careless and irregular manner, and that little or no attention has been paid to the various instructions and orders issued from time to time for his guidance), I made no attempt to verify his statements. No excuse whatever can be admitted in extenuation of the offence of entering the observations as having been taken at the exact times noted, when, in reality, they have been knowingly taken at some other entirely different hour. In addition to the evident mistakes in the 4 P.M. readings, observations purporting to be taken at 6 P.M. had been taken at or before 4 P.M.

"The condition of the observatory indicated great carelessness on the part of the observer. The thermometers were in very fair order, except that they were generally somewhat dirty. The minimum wet bulb and ordinary wet bulb were covered with a thickish encrustation.

"The wind vane worked slowly and heavily. This was accounted for by the fact that it had not been oiled for some months. The anemometer was excessively dirty, and was covered with dust inside and outside. No oil had been given to it for months. In consequence of the dust and want of oil, the instrument moved with much friction. It is evident that the anemometer observations have been of litte value for some time past. The Durbanga observer was informed that carelessness in observation, or laxity with regard to hours of observations, once clearly detected in an observer, throws a doubt for a long time over future observations, and that it would therefore take long for him to thoroughly re-establish a character for accurate work; and was informed that he would probably lose his personal allowance of Rs. 5 per mensem. I referred the matter to Mr. Blanford, explaining to him the peculiar condition of the observatory and the promise of the observer to do good honest work in future. He requested me to fine the observer ten rupees as a mark of his serious displeasure, and to warn him that the detection of any similar faults in the future will be certainly followed by the withdrawal of the personal allowance.

"Gya was inspected on the 11th and 12th of December 1882. No change has been made in the position of the instruments since my last visit, and the shed was in perfect order. The barometer was carefully examined, as the barometric observations had been unsatisfactory for some time. The readings for some months, as indicated by the observations at the neighbouring stations, had been much too high. A long and careful comparison, made by myself at the dâk bungalow, proved that no change had taken place in the index error of the instrument since its issue to Gya. I however found, when the observer was asked to take a reading of the instrument, that he immersed the fiducial point well into the mercury in the cistern, instead of setting it so as to touch exactly the mercurial surface. This error at once explained the high readings at Gya. I spent several hours in endeavouring to teach him to adjust the level of the mercury to the fiducial point, and in reading the instrument with fair results. The observer attributes his error in this respect, chiefly to failing sight. This was, however, not confirmed by the Civil Surgeon. It is therefore more probably due to carelessness, and he was warned on this point to be much more careful in future. The instruments were all in good order. The observer, I found, read the anemometer very imperfectly, and it was necessary to spend some time in training him to read it correctly. The condition of the Gya observatory, in consequence of these imperfections on the part of the observer, has been for some time far from satisfactory.

"Berhampur was inspected on the 28th of December 1882. The instruments have been housed in a new shed since my last visit. The shed is very neatly built and is in capital condition; the instruments were clean and in thoroughly good working order. This observatory is in almost every respect one of the best kept in Bengal, and reflects great credit on the observer, who is, I have every reason to believe, as accurate in his observations as he is interested in the neat appearance of his observatory.

"Burdwan was inspected on the 29th December. I found both the shed and instruments in perfect order. The observatory is in thoroughly satisfactory condition and continues to maintain its high character."

Dacca was inspected at the end of November. The shed is situated in the compound of the Telegraph Office in a fairly exposed position. It was in good condition, and the instruments clean and in excellent order. This observatory was last visited by Mr. Pedler in December 1878, when it was favourably reported upon.

The observatory at False Point has been located at the Jumboo Telegraph Office, for the past four years. This office was closed on the 25th of April 1882. No previous intimation was given to me of this change. The observations at False Point were then suddenly broken off, and I was unable for some time to make any arrangement for the re-establishment of the observatory. In August, the light-house was connected by telephone with Cuttack. This enabled me to re-establish the observatory under its former conditions before its removal to Jumboo, and at the same time to preserve the advantage of telegraphic communication with Calcutta. It was not considered advisable to erect a shed until the cold weather. Mr. Workman, light-house keeper, took the greatest interest in its re-establishment at the light-house. He procured the instruments from Jumboo and placed the barometer in the lower room of the light-house and the thermometers temporarily in a verandah facing the north, and forwarded daily telegrams of the height of the barometer, wind direction and force, rainfall, &c., from the 7th of August. I visited False Point in January, and in conjunction with Mr. Workman selected a suitable site for the new shed and for a pillar, on which to erect the wind vane and anemometer. This station is a very important one in connection with the Storm Signal Service, and it is to be regretted that the telephonic mode of communication usually fails during stormy weather. Mr. Workman informs me that he has frequently spent a couple of hours, shouting himself hoarse, in endeavouring to communicate with Cuttack during windy and stormy weather. If the Telegraph Department could arrange to improve the communications between the light-house and Hookeytollah or Cuttack, the False Point observatory would be under its present conditions one of the most satisfactory and important of my observatories.

Of the third class observatories, Berhampore, Burdwan, Dacca, Darjeeling and False Point take first rank for the accuracy and value of their observations. Purneah is now a fairly satisfactory observatory. Silchar and Jessore I was unable to visit during the past year, and can only judge of them by their returns. So far as they indicate, these two observatories have improved during the year, more especially Jessore, the returns from which have been neatly prepared and sent in with commendable regularity.

Durbhanga and Gya have been the most unsatisfactory of my stations during the past year. At Durbhanga the observer had allowed himself to fall into very careless habits and methods of observations, and I hope after the leniency shown to him he will use every effort during the present year to submit accurate observations and keep his instruments in such a condition as to be fit for inspection at any moment.

Akyab has been also a somewhat unsatisfactory station during the past year. I recorded my opinion in the Administration Report for 1881-82 that it was not quite satisfactory, as frequent mistakes were made in the transmission of weather telegrams. It is an important station, from its position on the Aracan coast. I regret to have again to record that numerous mistakes have been made in the preparation of the weather telegrams, due either to haste or carelessness. In the month of August last ten of the thirty telegrams despatched were erroneous in one or more particulars. The ordinary returns also frequently contain errors, and it is only too probable that the carelessness, shown in the preparation of the telegrams and ordinary returns, extends to the work of observation itself. It contrasts most unfavourably in these respects with Cuttack, Dacca, and Saugor Island, at all of which Telegraph Masters are observers.

Rainfall-recording stations.—Regular rainfall returns have been received during the past year from 164 sub-divisional stations. During the past year two stations—Segowlie and Baripore—have ceased to send in returns, as they are no longer sub-divisions; on the other hand, rainfall returns were received during a part of the year from three new stations—Netrokona, Banki, and Hookeytollah (False Point). The number of stations submitting rainfall returns at the end of the official year was 162.

These returns were submitted in the great majority of cases punctually, and the monthly return of rainfall throughout the provinces for each month of the past year, prepared from these returns, was published in the Gazette on the third or fourth week of the ensuing month.

Instruments.—The two following tables show the number and kind of instruments that have been broken or lost or rendered unserviceable at the Bengal observatories during the year 1882-83, and of the instruments supplied to the observatories to replace broken, deteriorated or untrustworthy instruments.

Return of Instruments broken or otherwise injured at the Observatories in Bengal and Assam, 1882-83.

Stations.	Barometer.	Hygrometer.		Dry Maximum.	Minimum Thermometer.		Radiation Thermometer.		Anemometer.	Wind vane.	Rain-gauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Patna	...	...	...	...	...	...	...	...	...	...	...	...	...	...	(c) 1
Cuttack	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..
Chittagong	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Saugor Island	...	...	...	...	...	...	...	...	(a) 1	...	...	...	...	...	...
Hazaribagh	...	...	...	...	...	(a¹) 1	...	(a¹) 1	...	...	...	...	...	...	...
Purneah	...	...	...	...	...	...	..	...	...	...	...	...	...	.	...
Burdwan	...	...	...	...	...	...	...	...	...	...	...	...	...	.	..
Berhampore	...	...	...	...	...	...	(b) 1	(a) 1	...	...	...	.	...	...	...
St. Paul's School, Darjeeling	...	...	...	...	...	...	...	(d) 1	...	...	...	...	...	..	...
Jessore	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...
False Point	...	...	...	...	...	...	...	...	...	...	...	...	..	..	...
Dacca	...	...	...	...	(a) 1	...	...	...	(a) 1	...	...	...	...	...	..
Durbhanga	...	...	...	...	..	...	...	...	(a) 1	...	...	...		...	...
Gya	...	...	...	...	...	...	...	(d) 1	...	...	...	...	...	...	...
Akyab	...	...	...	...	(a) 1	(a) 1	(d) 1	...	...	...	...	...	..	..	..
Gopalpore	...	...	...	...	...	...	...	...	...	...	...	...	..	..	
Sibsagar	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...
Dhubri	...	...	...	...	...	...	...	(e) 1	...	...	...	...	...	•	
Cachar	...	...	...	...	...	...	...	...	...	...	...	...	...	..	..
Tura	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Demagiri	...	...	...	...	...	...	...	...	...	...	...	...	...	..	..

(a) Out of order. (a¹) Condemned. (d) Broken.
(b) Cracked. (e) Stolen.
(c) Broken in transit.

Comparatively few instruments were broken during the year. At Gya, the terrestrial radiation thermometer was broken to pieces by a stone thrown from a road outside the compound. An exposed grass radiation thermometer disappeared at Dhubri under circumstances which indicated that it had been probably stolen by coolies travelling up to the Assam tea gardens, a depôt for whom is within a few yards from the observatory. The instrument which was broken at Akyab is reported to have fallen by accident to the ground when it was being examined by the observer.

During my tour of inspection I condemned several instruments, more especially alcohol minimum thermometers, which frequently deteriorate rapidly in India, and ordered them to be replaced by new instruments. This, for example, explains the issue of thermometers to Hazaribagh, Berham-

pore, Patna, and False Point. On the whole, the instruments appear to have been carefully looked after during the past year.

Central Office.—The office establishment consisted of the following clerks on the 31st of March 1883:—

Names.	Rank.	Salary. Rs.
Babu Chandi Churn Chatterjee	Head Clerk	80
„ Poorna Chunder Mookerjee	Second do.	43
„ Jogesher Roy	Third do.	25
„ Kamini Mohun Bosu	Tabulator	32
„ Banikant Roy Chowdhury	Do.	22
„ Bireshar Mookerjee	Do.	20

Babu Chandi Churn Chatterjee is active and intelligent, and is a very efficient Head clerk. He has controlled and managed the office very successfully during the past year, and thus enabled me to propose, without hesitation, extensions for the improvement of the Department, which I would otherwise have found it difficult to carry out.

No change was made during the year in the ordinary routine of the office. The following returns have been prepared during the year for publication in the *Calcutta Gazette*:—

1st.—Monthly summaries of the meteorological observations taken at twenty observatories in Bengal and Assam.

2nd.—Monthly statements of rainfall at 162 sub-divisional and other stations in Bengal, and in the same form as last year.

3rd.—A table showing the monthly and total rainfall for the year 1882 at 162 stations in Bengal.

4th.—A table giving the average monthly and annual rainfall at 156 stations in Bengal, based on the rainfall returns up to 31st December 1882.

5th.—Comparison rainfall table for the year 1882, showing the monthly and total variation of the rainfall of 1882 at 162 stations, from the mean rainfall given in the preceding table.

My time has been more fully occupied than usual during the past year, and I have thus had less leisure to devote to meteorological investigation apart from the ordinary routine of my work.

I have nearly finished an analysis of the storm of October 1882, which possessed several features of interest. It occurred during the October transition period, when there is a tendency for any vortex that is formed in the Bay to develope into an intense and severe cyclone. Although it formed at the most dangerous period, during pre-existing conditions, which are known to be favourable to cyclonic formation of the Bay, some condition or action was absent, or very feebly developed, which prevented the storm acquiring great intensity. It was due to, and accompanied, a large shallow depression with moderately high gradients on the outskirts of the storm area. The aqueous vapour condensation, judging from the appearance of the sky during the storm, seems also to have taken place at a comparatively low level. It was economically chiefly remarkable as giving the heaviest and most general burst of rainfall to Bengal during the south-west monsoon of 1882.

In several respects, it resembled the storm of September 1878, the account of which I drew up last year, and which was published during the present year as the first paper in the second volume of the Meteorological Memoirs.

I also took up for discussion all the storms which occurred in the Bay of Bengal during the period 1875 to 1880, of which there are records in the office, with a view to determine the relations between storm occurrence in the Bay and the general character of the monsoon, and also, if possible, the distribution of south-west monsoon storms in the Bay with respect to time and place.

This I find will take longer to work out than I originally expected, but I hope to finish it in the course of the present year.

Storm signals.—In my last year's report I stated that, I had submitted to the Government of Bengal, proposals for the extension of the system of storm signals for warning the Port of Calcutta of the approach of cyclones. The original object of this part of the work of the Bengal Reporter

was to forewarn the port of the approach of severe cyclones, such for example as those of 1864 and 1867, in order that captains of vessels, &c., might prepare for the advent of the attendant destructive storm-wave. Recent experience has, however, shown that, although severe cyclones accompanied by storm-waves are of comparatively rare occurrence at the head of the Bay, cyclonic storms of limited extent and intensity are, on the other hand, frequently formed during the rains, and are a source of danger to shipping entering or leaving the mouth of the river. The storm signals hitherto employed were only intended to give warning of the formation and approach of storms of the first kind; hence it became necessary, if the Department was to give warning of the advance of storms dangerous to shipping in or near the mouth of the river, as well as to shipping in the port, to extend or modify the system of signals. This I did with the assistance of Mr. Elson, Master Pilot, in such a way as not only to differentiate between the intense cyclones of the transition periods, and the feebler cyclonic storms of the rains, but also to indicate roughly what part of the Bengal coast they are approaching and likely to cross. The Government of Bengal sanctioned the proposed signals on the 5th of August 1882.

The adoption of the new system of storm signals was duly notified in the *Calcutta Gazette* on the 9th August 1882. They were brought into operation almost immediately afterwards, and as soon as the new signals could be prepared and despatched to the signal stations. Signals, giving warning of the existence of any dangerous storm near the head of the Bay, will in future be hoisted for the information of the pilots, captains of vessels, &c., at Saugor Island, Mud Point and Diamond Harbour. Signals will in future be hoisted in Calcutta only before the approach of a severe cyclone with a storm-wave of sufficient magnitude to be probably dangerous and destructive to shipping in the port. The storm signals in the port of Calcutta will be hoisted in the following positions:—

1st.—On the Port Commissioners' office.

2nd.—On a flagstaff at Seebpore, nearly opposite to the Fort.

3rd.—On the yardarm of a flagstaff near the Government Dockyard, Kidderpore.

No severe cyclone occurred in the Bay during the year 1882. Six cyclonic vortices formed near the head of the Bay, and advanced across the Bengal or Orissa coast into the interior. These were—

1st.—Storm of June 8th to 17th, which ushered in the south-west monsoon. The centre crossed the Orissa coast on the 10th.

2nd.—Storm of 16th to 23rd of July. This crossed the Bengal coast near the mouth of the Hooghly on the 19th.

3rd.—Storm of 5th to the 14th of September, which crossed the Orissa coast between False Point and Balasore on the 7th.

4th.—Storm of the 14th to 19th of September, which advanced across the Orissa coast on the 16th.

5th.—Storm of the 26th of September to the 3rd of October. This crossed the Orissa coast on the 28th.

6th.—Storm of the 12th to 17th of October, which formed near the coast of the Northern Circars, crossed the Ganjam and Orissa coast, probably between Gopalpore and Pooree early on the morning of the 15th, and then proceeded northwards into Northern Bengal.

Four of these storms, *viz.*, 2, 4, and 5, although accompanied with moderately strong winds and a rough sea, did not appear to be of sufficient intensity to justify the hoisting of the storm signals. Warning signals were hoisted for storms Nos. 3 and 6. On the approach of the 3rd storm bad weather signal No. 7 was hoisted on the 7th September at 12-30 P.M., intimating that a small cyclonic storm was advancing to the east of the Hooghly. This was changed on the receipt of further information to storm signal No. 8 at 7-30 A.M. of the 8th. The signals were taken down at 2 P.M. of the 9th. During the sixth storm, signal No. 5, intimating the existence of a storm which would cross the west coast south of False Point was hoisted at 2 P.M. of the 14th; the signals were taken down at noon of the 16th.

Daily Weather Reports.—These have been published during the past year in the same form as during the previous. They were supplied to 27 subscribers and to 23 Government officials at the commencement of the official year, and to 29 subscribers and 30 Government officials at the end of the year. The receipts during the year from subscriptions have covered the cost of printing and distributing the reports. There was a small balance of Rs. 105 at the end of the year, which was kept in hand in order to meet any charges for repairs to the lithographic presses.

The report has hitherto been published on an awkward, large-sized sheet of inferior paper which has detracted considerably from its appearance. By reducing the size of the form considerably, I have been able to obtain paper of much better quality for the report and chart. Through the courtesy of the Superintendent of the Lithographic Department of the G. T. Survey, I was supplied with a neat chart and form from which to prepare the daily reports. The report will thus in future (from May 15th) be issued in a neater and more compact form. Although the number of subscribers has not increased much, I believe the report and chart are found to be of use. I should be glad to see the number of subscribers increased, so that the subscription could be reduced from Rs. 2 per mensem to Rs. 12 per annum.

Marine Meteorology.—A fair amount of work has been done in this during the past year. The Government of India sanctioned additions to the previous office establishment with effect from the 1st of April. The work proposed to be done under this head consisted of two parts. The first is the discussion of the observations taken on board vessels navigating the Indian seas, collected by the Board of Trade in England some years ago, and made over to the Indian Meteorological Office; and the preparation of charts embodying the information given by these observations of the pressure, winds, currents, &c., in the Bay of Bengal and Arabian sea. During the early part of the year the barometric observations were taken up with a view to determine the amount and character of the diurnal oscillation in the Bay. The curves have been worked out for all the months, excepting December, and are ready for publication whenever it may be considered desirable to do so. Shortly after Mr. Dallas, Scientific Assistant, came down to Calcutta from Simla, he took over the work of tabulating and charting the data. Four additional clerks were engaged. The barometric and wind data for January were gone through and tabulated, and the results charted. The second branch of the work of the Department is the collection of current meteorological data of the Bay of Bengal from every possible available source. Forms were prepared in accordance with suggestions made by the Port Officer. A supply of these is included in the papers handed by all pilots to the captains of vessels entering the river on taking piloting charge. A large number of captains have complied with the request of the Department to furnish extracts of meteorological data in these logs for the Bay of Bengal and Indian sea. Three hundred and forty-five sets of returns were filled up and sent in to this office. Many of these are of great value, and show that accurate meteorological observations are taken on board a fair proportion of the ships navigating the Bay of Bengal. The information contained in these has been extracted and entered in books for permanent record in such a way that the information for any one day is collected together. The information they give is also being added to the daily weather charts for India, prepared in the India Meteorological Office. I have not had time to go through this information as fully as I should have wished, but the extracts I have considered indicate clearly the general truth of what I had previously surmised, *viz.*, that the weather in the whole extent of the Bay, excluding the Andaman sea, is fairly indicated by the observations taken at the coast stations, and that the progress of every important storm may be traced and followed with more or less exactness almost from its origin, from the shore observations.

In addition to this information, observations with verified instruments have been taken at 10 A.M. and 4 P.M. on board the light-vessels near the mouth of the Hooghly. The following gives the dates from which returns have been received during the past year:—

Meteor	from	May	1882.
Star	„	June	„
Comet	„	August	„
Mermaid	„	November	„

The observations taken on board these vessels are, I have every reason to believe, after careful examination, to be accurate and trustworthy. They are very valuable as extending our knowledge of the meteorology of this part of India to a distance of 40 miles beyond the coast seawards.

FINANCE.

The following statement gives the total cost to the State of the Bengal Meteorological Department during the year 1882-83:—

	₹ a. p.	₹ a. p.
Meteorological Reporter	3,600 0 0	
Office establishment	2,764 1 10	
Office rent	900 0 0	
Observers { Telegraph Masters[1]	2,325 0 0	
Observers { Native observers	3,480 0 0	
Messengers' allowances	78 0 0	
Superintendents' allowances	1,440 0 0	
		14,587 1 10
CENTRAL OFFICE.		
Contingent and office furniture	571 6 9	
Postage	507 9 0	
Telegraphic messages	9,646 4 0	
Travelling allowances	926 8 0	
		11,651 11 9
OBSERVATORIES.		
Building and repairs	473 6 9	
Contingent	83 9 0	
		556 15 9
GRAND TOTAL		26,795 13 4

The total is Rs. 2,155 in excess of last year. This is, however, due almost entirely to increase in the nominal charges for telegraphic messages and postage. The weather telegrams for the use of the Calcutta Storm Signal Service were despatched throughout the year as "urgent." This caused the large increment under that head. The increased correspondence and circulation of the Bay of Bengal daily weather reports to Government officials explains the increment under the head "Postage." Building and repairs were well within the budget allowance, in consequence mainly of the large expenditure under this head last year.

The statement does not include the cost of instruments supplied to the observatories by the Indian Meteorological Department, nor does it include the cost of stationery supplied to the central office, or of printing the various forms required by the office, nor of printing the meteorological returns published in the Gazette or otherwise.

JOHN ELIOT, M.A., F.M.S.,
Meteorological Reporter to the Government of Bengal.

METEOROLOGICAL OFFICE, BENGAL;
The 30th May 1883.

[1] Paid through the Telegraph Department.

APPENDIX B.

Administration Report of the Meteorological Reporter to Government, N.-W Provinces and Oudh, for the year 1882-83.

No changes of any importance have occurred in the working of the Department during the year. No new observatories have been opened, nor have any of the old ones been closed; and the only changes that have taken place in the status of the existing observatories have been the admission of the voluntary one at Pithoragarh to the list of Government third class observatories, from the 1st May 1882, and the complete equipment during the year of the Jeypore observatory as one of the first class.

At the beginning of the current year, the observatories reporting to the Allahabad office were twenty in number—fifteen in the North-Western Provinces and Oudh, three in Rajputana, and two in the Central India States. In the following table these observatories are classified according to the kind of observations they furnish and also according to the way in which the observers are paid :—

How maintained.	Class.		
	I.	II.	III.
By Meteorological Department	Allahabad (in abeyance).	Allahabad Lucknow Agra Roorkee	Chakráta. Ranikhet. Pithoragarh. Bareilly. Gorakhpur. Benares. Sutna. Jhansi. Ajmere. Sambhar.
By other Government Departments	.....	.....	Dehra.[1] Gházipur.[2]
Voluntarily or by Independent States, &c.	Jeypore[3]	.....	Meerut.[4] Nowgong.[5] Pauri.[5]

[1] Maintained by Survey Department.
[2] Ditto Opium Agency.
[3] Ditto State Durbar.
[4] Maintained by Municipality.
[5] Observers unpaid.

A list of the observers and Superintendents who have held charge of these observatories during the year, and of the periods during which they acted, will be found in Appendix B. III.

Observatories of the First Class.

Allahabad.—The question of the construction of a first class observatory for these Provinces has advanced during the year, but only very slightly. It has now been finally decided to build the observatory at Allahabad instead of at Cawnpore, Lucknow or elsewhere; and plans for a building to accommodate the observatory and the meteorological office are now being prepared in the Executive Engineer's office at Allahabad. But it is possible that the question of a site for the observatory in Allahabad may be re-opened; because, at the site already determined upon, in the Muir College compound, no building except one designed by the architect of the college can be erected without the possibility of injuring the college from an architectural point of view. Should a new position be

determined upon, the observations of temperature and humidity which have been made at the college since the middle of April 1882, and are still being carried on, will be useless.

These observations, printed in Appendices V and VI, indicate that the mean temperature at the college is three quarters of a degree higher than at the old observatory; that the differences are greatest in the cold weather months, when they amount to 1·5°; and that the minimum temperatures differ but slightly, while the maxima differ considerably, the daily range being consequently a degree larger at the college than at the old observatory, on the average of the year, and three degrees larger in December. The observations also indicate that the air is very considerably drier at the new than at the old site, at all times of the day, but especially at 10 A.M.

The differences in the meteorological constants of the two places, thus brought to light, are so large, that it has been thought necessary to extend the comparison for another year, especially as some of the series of observations—those relating to radiation—are incomplete, the railing which surrounds the observatory shed at the college and protects the exposed instruments not having been put up until near the end of the year. These differences are almost certainly due to the peculiar position of the old observatory, in a low-lying, well-wooded garden, where, in winter, when the sun does not rise high in the heavens, the ground near the thermometer shed is shaded during the greater part of the day. It is highly probable that differences equally great will be found between the old observatory and any open place in the vicinity; and therefore if an entirely new site be ultimately fixed upon for the observatory, a new series of comparative readings, extending over one or two years, must be made.

At present, as in former years, Allahabad continues to work as a second class observatory, additional observations being made however at 4 A.M. and 10 P.M., and various special observations being carried on as well. The observer, Babu Kedar Nath Chatterji, continues to do excellent work, and has therefore been allowed to retain for another year a special allowance of Rs. 10 per mensem in addition to his pay.

Jeypore.—Under the energetic superintendence of Dr. Hendley, and with the able assistance of Major Jacob, R.E., a handsome building, in Indian style, was erected for the accommodation of the Van Rysselberghe meteorograph with its various accessories, and the instrument was installed and brought into action early in the year. A short account of the administration of the Jeypore Meteorological Department by Dr. Hendley is given in the Appendix II. The observatory was inspected by the Meterological Reporter for India at the commencement of the cold weather, and I visited it in December. The ordinary instruments at the time of my visit were all in perfect order, and the meteorograph was working beautifully, except that the wind direction apparatus was slightly deranged.

The monthly registers of eye observations of the various instruments, made on the system pursued at Allahabad, have been regularly received, and on examination prove, as far as may be judged from internal evidence, that the observations were carefully taken. These already constituted a valuable series of meteorological data for a part of the country previously unrepresented, and the records of the meteorograph will be still more valuable.

Observatories of the Second Class.

Lucknow.—The work of this observatory has been carefully performed during the year by the observer, Babu Chotay Lal, who has sent in the monthly registers neatly written, generally correct as regards arithmetical work, and punctually prepared. The observatory was inspected in May, when all the usual instruments were found clean and in excellent condition. The Beckley anemograph had been removed to the new and better position, mentioned in last year's report, but though it now works much better than formerly, the velocities indicated by it are still too low to be perfectly trustworthy, doubtless because there are still some buildings and trees in the neighbourhood higher than the instrument.

Babu Chotay Lal has also been allowed to retain for another year his personal allowance of Rs. 10 per mensem.

Agra.—This station was inspected in December. The instruments were found to be clean and generally in good order at the time of my visit, the exceptions being the raingauge and the solar radiation thermometer. The latter had a small quantity of mercury, equal to about 0·30 of the scale condensed at the top of the tube. The raingauge funnel was not quite level, probably owing to some unrecorded change in the receiving bottle, for the tube of the funnel, which was rather long, touched the bottom of the receiver before the funnel came down into its proper position. This was remedied by cutting an inch off the end of the funnel tube. Since my visit, the raingauge has been surrounded for protection by a stout wooden paling, and all the buildings, &c., are now in good order.

The observer, Mir Altaf Ali, though he generally takes good care of the instruments and reads them correctly, has during the year made frequent mistakes in the reduction of the observations, and his registers and returns have often been written in a careless and slovenly manner, though latterly they are much improved. His personal allowance has therefore been reduced this year from Rs. 10 to Rs. 5 per month.

Roorkee.—This observatory was not inspected during the year. The returns have been punctually received and have apparently been prepared with care. From the evidence of the registers, the observations seem to have been made punctually and accurately, and this is the opinion of the Local Superintendent, Dr. Murray Thomson, regarding their character. In reducing the registers and striking the monthly means, however, the observer, Babu Chiranji Lal, still makes mistakes, and therefore, while in recognition of the general improvement in his work he has been recommended for a special allowance this year, it is an allowance of only Rs. 5 per month.

OBSERVATORIES OF THE THIRD CLASS.

Chakrata.—This station was not inspected. The returns have been punctually received and the observations appear generally to have been carefully made. The observer, Munshi Salig Ram, retains this year the personal allowance of Rs. 5 per month previously granted to him.

Ranikhet.—The observatory at Ranikhet was inspected at the beginning of June. The buildings were all in good order except the barometer room in the observer's house, the earthern floor of which was very damp. A new floor of boards has since been laid down. The instuments were clean and in good order. The anemometer, which is now mounted on a pillar about 4 feet high above one of the gables of the observer's house, seems to record considerably less movement than it did in its former position on the stump of a large pine tree. The observer, Pandit Jewa Nand, who has managed the observatory very well for several years without any Local Superintendent, gets this year an allowance of Rs. 10 per mensem in addition to his pay.

Pithoragarh.—This station, which has not yet been inspected, was brought on the list of Government observatories on the 1st May 1882, having been opened a year previously as a voluntary one. The Superintendent, the Rev. Dr. Gray, has looked carefully after the work of the observer, and the observations have consequently been very carefully taken; but Dr. Gray has recently removed his head-quarters to Almora, and will in future visit Pithoragarh only at intervals of two or three months. It remains to be seen whether the observer will be able to maintain the high character of the observations when left a good deal to himself. Hitherto there have been no signs of deterioration.

Bareilly.—This observatory was inspected in May. The observatory shed and surrounding railing required slight repairs, which have since been executed. The clock was five minutes fast by railway time, though the local time should be about six minutes slow. The instruments were generally in good order, but some of them were very dirty, the barometer being covered with splashes of white-wash, and the wet bulb thermometers thickly coated with a lime deposit, which had been rendered insoluble by sulphuric acid. The solar thermometer had a quantity of mercury equal to nearly 2° of the scale collected at the top of the tube, and never allowed for or even observed. For his general carelessness the observer, Munshi Jwala Prasad, was severely reprimanded. It is hoped that he will do better in future.

Gorakhpur.—This observatory was not inspected during the year. The returns have been regularly received, but the present observer, Hospital Assistant Nizam-ud-din, who has not been

long at the work, makes mistakes sometimes in reading the instuments, and does not seem to understand properly the use of decimals. On the whole, however, his work has been fairly good, but he has not been recommended for any of the special allowances.

Benares, Sutna.—Neither of these stations was inspected during the year. The returns have been regularly received and the observations of each appear to maintain their previous character for accuracy. The observers, Devakinandan Pathak and Har Nath, retain the special allowances of Rs. 5 per month previously granted them.

Jhansi.—The observatory at Jhansi was inspected in December. The thermometer shed was in good order, but the dispensary building (not belonging to the Meteorological Department) in which the barometer was hung, was in a condition which might be described as dangerous. Owing to the widening of a crack in the wall against which the barometer was hung, this instrument had gone a little out of the perpendicular, but was otherwise in good order. It has now been removed to another wall, which seems sounder than that on which it formerly hung. The thermometers were generally in good condition, but a quantity of mercury equal to 2° of the scale had collected at the top of the solar radiation instrument. The enclosure round the raingauge and radiation instruments required renewal, and this has since been done. The anemometer and wind vane on the roof of the dispensary had been overtopped by young trees since the time of my previous visit, and as it was impossible to raise a pillar on the roof on which to mount them at a greater elevation, they were taken down and will now be put up on a special scaffolding erected in an open spot at some distance. The observer, Hospital Assistant Kalka Das, has been many years in the Department, and has done fairly good work, but owing to his inattention to small but important details fully described in the book of instructions, he has not yet been recommended for any special allowance.

Ajmere, Sambhar.—These stations have not been inspected this year. The returns have been punctually received and have generally been correct, though the Sambhar observer still makes occasional mistakes. The work of the Ajmere observer, Munshi Ram Parshad, who has been many years in the Department, has been very well done during the year, and he has been recommended for a special allowance of Rs. 5 per month.

Other Observatories.—Of the third class observatories, not maintained by the Meteorologicals Department, none were inspected during the year except Nowgong. At this station the instruments were generally found in good order, almost the only fault to be found with the practice of the observer being the common and constantly recurring one of using well water for the wet bulb thermometers. The barometer had been removed into an inner room, where the light was defective, when the room in which it was formerly kept was under repair, and had not been put back again, but it has now been restored to its original position. On comparison with two similar instruments taken with me the barometer was found to read ·008″ lower than when its index error was determined in Calcutta.

The observations made at all the voluntary stations have been regularly received, and abstracts of the results published along with those of the Government observatories.

Supply of Instruments.

The instruments issued to the observatories have as usual been obtained through the Calcutta Meteorological Office, only a small stock being kept at Allahabad. Full details are given in Appendices C, D, and E.[1] These tables do not include a number of raingauges obtained at the expense of the Provincial Government and issued to the revenue stations, for the most part, during the year under report.

The number of instruments broken or damaged during the year was small, the losses occurring chiefly among the radiation thermometers, which, being freely exposed, are very liable to accidents.

Rainfall Registration.

New raingauges of Symons' pattern were issued during the year to all the revenue stations which send direct reports of rainfall to the central meteorological office, and a few spare ones are kept

[1] Appendix C of this report is incorporated in the general list in Appendix I. D is here numbered B IV, and E is omitted.

in stock. The new gauges are to be read for a year simultaneously with the old ones, before the latter are disused. In this way, it is hoped, that factors may be arrived at, which will enable us to deduce the true rainfall from the past observations of the old gauges.

My report on the rainfall of the province, published in the year 1878, having been out of print for some time, a new set of tables giving the approximate annual mean rainfall of 496 places in the province have been prepared, and the results laid down on a map which is being printed for general distribution among district and canal officers.

Special Observations.

In addition to the ordinary observations special observations of soil temperatures have been carried on during the year at Allahabad and Jeypore, and I believe also at Dehra, though the observations made at Dehra have not been communicated to the Allahabad office. At Allahabad the temperature is taken four times daily at half an inch, 1 foot, and 3 feet below the surface; and at Jeypore observations are made at the surface and at depths of 4 inches, 1 foot, 3 feet, 10 feet, and 20 feet. The results for the year under report are given in Appendices H and I.[1] Hourly observations of the earth thermometers were made at Allahabad on four days in each month, with the object of determining what corrections should be applied to the mean of the 4, 10, 16, and 22 hour observations to reduce them to the true daily mean. The deduced corrections are the following :—

Depth.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
½ Inch.	—0·4°	—0·4°	—0·5°	—0·4°	—1·1°	—0·3°	0·0°	—0·1°	—0·4°	—0·4°	—0·4°	—0·4°
1 Foot.	—0·04	—0·01	—0·03	—0·05	0·00	+0·01	—0·02	+0·00	+0·06	0·00	—0·03	0·00
3 Feet.	—0·01	0·00	—0·05	0·00	0·00	0·00	0·00	+0·01	+0·05	—0·01	—0·02	+0·01

These corrections have a sensible value for the thermometer nearest the surface, but for the others they are very small and irregular. The diurnal range at the depth of 1 foot is less than 2°, and at 3 feet depth it is almost insensible in some months, and does not average 0·2°. In the table for Allahabad. the temperatures at half an inch below the surface have been corrected for diurnal variation and the others are uncorrected. The figures for Jeypore are all uncorrected for this inequality.

Including the month of April 1883, we have, for Allahabad, a series of ground temperature observations extending over three complete years. In the following table, the corrected monthly means of the three thermometers and the mean temperature of the air are compared, the second column under each heading giving the means freed from annual inequality. During the two years from November 1880 to October 1882, it appears that the temperature both of the ground and of the air diminished by about 1·5°, the decrease being fairly steady and uniform, but greatest at the ground surface. On the average of all the observations the thermometer at a depth of 1 foot stands a degree lower than that at 3 feet, but is nearly identical with the corrected temperature at the surface. The high temperature at a depth of 3 feet is probably either due to a wave of heat which reached its maximum before the commencement of the series, or more likely to an error in the thermometer.

Month.	Air in shade.		Ground ½ inch below surface.		Ground 1 foot deep.		Ground 3 feet deep.	
	Mean.	Corrected for annual inequality.	Mean.	Corrected for annual inequality.	Mean.	Corrected for annual inequality.	Mean.	Corrected for annual inequality.
	°	°	°	°	°	°	°	°
May 1880 . . .	91·3	.....	98·0	.....	94·6	.....	89·4	.....
June „ . . .	94·2	.....	100·1	.....	97·0	.....	92·8	.....
July „ . . .	83·1	.....	86·2	.....	87·7	.....	88·7	.....
August „ . . .	84·2	.....	87·6	.....	87·3	.....	87·0	.....
September „ . . .	82·6	.....	86·4	.....	86·8	.....	87·0	.....
October „ . . .	79·9	.....	87·1	.....	84·8	.....	86·0	.....

[1] These are here omitted, but will be given in the report on the meteorology of the year.

Month.	Air in shade.		Ground 1 inch below surface.		Ground 1 foot deep.		Ground 3 feet deep.	
	Mean.	Corrected for annual inequality.	Mean.	Corrected for annual inequality.	Mean.	Corrected for annual inequality.	Mean.	Corrected for annual inequality.
	°	°	°	°	°	°		
November 1880 . . .	66·4	77·52	72·7	82·90	73·5	81·53	77·4	82·…
December ,, . . .	59·1	77·33	64·0	82·52	64·7	81·51	72·0	82·24
January 1881 . . .	58·2	77·17	63·0	82·14	62·9	81·37	67·…	82·19
February ,, . . .	68·6	77·13	73·9	82·11	71·0	81·36	71·…	82·19
March ,, . . .	74·0	77·07	79·8	82·07	77·8	81·36	77·4	82·21
April ,, . . .	88·4	76·97	95·7	81·82	90·1	81·24	84·8	82·17
May ,, . . .	91·8	76·80	98·5	81·37	96·3	80·88	9…·9	82·02
June ,, . . .	89·1	76·75	90·4	81·12	93·6	80·…	92·0	81·94
July ,, . . .	84·3	76·85	86·8	81·06	87·6	80·…	88·4	82·02
August ,, . . .	82·2	76·75	86·4	80·83	87·0	80·93	87·2	82·08
September ,, . . .	83·1	76·80	86·7	80·64	87·2	80·87	87·4	82·07
October ,, . . .	77·0	76·97	80·8	80·52	81·4	80·79	84·7	82·…3
November ,, . . .	65·1	76·86	68·2	80·22	70·8	80·51	77·0	81·88
December ,, . . .	59·3	76·73	62·4	80·12	65·2	80·22	72·3	81·78
January 1882 . . .	60·4	76·65	63·3	80·12	64·2	80·09	70·4	81·54
February ,, . . .	64·1	76·65	68·0	80·16	68·7	80·11	71·9	81·57
March ,, . . .	79·6	76·65	81·3	80·26	78·8	80·16	77·2	81·52
April ,, . . .	87·1	76·60	91·1	80·27	87·2	80·17	83·9	81·46
May ,, . . .	90·2	76·54	96·0	80·23	92·5	80·25	88·3	81·43
June ,, . . .	87·8	76·55	90·3	80·22	90·4	80·38	89·6	81·41
July ,, . . .	83·5	76·54	87·1	80·17	87·7	80·45	87·7	81·38
August ,, . . .	82·8	76·38	87·1	79·90	87·6	80·30	87·5	81·20
September ,, . . .	82·8	76·07	88·5	79·44	87·5	79·96	86·9	80·91
October ,, . . .	76·0	75·99	79·2	79·21	81·6	79·76	83·9	80·70
November ,, . . .	64·7	.....	68·6	.....	72·5	.....	77·4	.....
December ,, . . .	60·0	.....	62·0	.....	66·5	.....	72·1	.....
January 1883 . . .	59·5	.....	62·2	.....	64·8	.....	69·…	.....
February ,, . . .	60·9	.....	62·7	.....	64·4	.....	68·1	.....
March ,, . . .	75·6	.....	75·6	.....	74·8	.....	74·0	.....
April ,, . . .	89·0	.....	91·5	.....	86·4	.....	82·0	.....
Mean for 3 years . . .	76·8	.....	80·8	.....	80·6	.....	81·6	.....

The excess temperature of the ground above that of the air at Allahabad is between 4 and 5 degrees. At Jeypore, the observations have not been continued long enough to give true average temperatures, but on the mean of the twelve months in the table, the average temperature of all the earth thermometers, except that at the surface, which requires a correction for diurnal inequality, was 4·2 degrees higher than that of the air. A similar excess having been found at Trevandrum, Calcutta, and Allahabad, it may be inferred with much probability to hold over the whole of India.

A self-acting sunshine recorder was brought into use in April 1882, and its traces have been filed for every day in the year except three. In the table in Appendix B. VII the percentage of bright sunshine recorded is compared with that of clear sky deduced from cloud observations at 10 A.M. and 4 P.M.

In all the months, except April and May, the percentage of recorded sunshine is considerably in excess, thus suggesting, as is not improbable, that the rays of the sun have a very considerable effect in dispelling cloud from his path across the sky. In April and May, when the air is full of dust, the recorded sunshine is defective, because when the sun is near the horizon, especially in the evening, his rays are so scattered by the dust particles, that the heat, concentrated in the focus of the lens, is not sufficient to burn the recording card.

In the clear weather at the close of the rains, on the other hand, the recorded sunshine frequently exceeds 100 per cent., no allowance having been made for refraction in computing the theoretical length of the day.

Office and Office Work.

The work of the office has been carried on by the same staff as in the previous year. The ordinary work has been kept fairly well up to date, the registers for each month being prepared and an abstract of the observations published before the end of the succeeding month or early in the second month after. The preparation of copies of the registers for transmission to the Calcutta office has however been a good deal delayed, the last registers for 1882 having been despatched as late as April 1883. As mentioned in last year's report, proposals for a slight increase in the office establishment were sent up during the year, but sanction has not yet been obtained. The establishment at present is the following :—

Name and Designation.	Monthly pay.
	Rs.
Chinta Money Ghosh, Head Clerk	88
Kaliprosono Datta, Second „	50
Makhan Lal Mukerji, Third „	30
Ram Charan Pande, Fourth „	20
Sasi Bhusan Banerji, Fifth „	20
And one peon	6

In addition to the usual monthly meteorological abstracts and the weekly and annual rainfall statements, a brief sketch of the meteorology of 1881 was prepared for the Provincial Administration Report, and a few spare copies were printed and circulated. The rainfall tables and map already mentioned were also prepared during the year, and I have written a paper on the temperature of North-Western India, which is now being printed for the *Meteorological Memoirs*.

Cost of the Department.

Details of the cost of maintaining the Meteorological office and the observatories in the North-Western Provinces and Oudh, are given in the last statement in the Appendix. The total expenditure, paid by the Government of India, exceeds that for the previous year by Rs. 1,087-12-3. This is accounted for by the addition of Pithoragarh to the list of paid observatories, the special allowances given to deserving observers, a slight increase of pay to the head clerk of the office, and the maintenance of the observatory buildings, formerly paid for partly by the Provincial Government.

S. A. HILL,

Meteorological Reporter to Govt., N.-W. P. and Oudh.

ALLAHABAD :
The 3rd May 1883.

APPENDIX B. II.

Meteorological Observatory, Jeypore.

[Extract from Dr. Hendley's Report.]

During the past year the observatory has become practically one of the first class, as automati readings of all the ordinary instruments have been more or less regularly recorded by the Mete orograph since August. In addition to the five soil thermometers in use in 1881 a sixth has been added to record the temperature at a depth of 20 feet.

The anemograph has yielded traces without interruption during the year.

Meteorograph.—The tower for the Van Rysselberghe Meteorograph was ready for the installation of the instrument early in May, but it was found impossible to get it into working order in less than three months. Owing to the motor having been packed in England with the springs half uncoiled, one of them had been broken, and much damage had been done to the delicate mechanism of the driving part of the instrument.

The skill of the Telegraph Master, Mr. Callaghan, who has been permitted to act as Electrician, and of Nund Kishore, an unusually clever native workman, alone enabled this and many other difficulties to be overcome. A careful statement of many practical points regarding the instrument not mentioned in the account published by the makers, has been prepared for the help of those who may have to erect another meteorograph in India.

Enclosure.—The railed enclosure round the ordinary instruments has been enlarged and a mud wall constructed to the compound.

Daily weather telegrams have been despatched throughout the year to Simla or Calcutta. The Meteorological Reporters to the Government of India and the North-Western Provinces have both inspected the observatory during the period under review.

Observers.—The observers have worked well, their salaries have been raised, and it is proposed to increase them by regular increments if they are favourably reported on.

General Remarks.—His Highness the Maharaja has visited the meteorological observatory on several occasions, and has shown much interest in all the Institutions.

APPENDIX B. III.

Names of the Superintendents and of the Observers at the Meteorological Observatories in North-Western Provinces and Oudh during the year 1882-83.

Observatory.	Class.	Officer in charge.	Date. From	Date. To	Observers.	Date. From	Date. To	Remarks.
Allahabad	Second	S. A. Hill, Esq.	1st April 1882	31st March 1883	Kedar Nath Chatterji, Observer	1st April 1882	31st March 1883.	
					Jadu Nath Chatterji, Observer, at the new observatory	Ditto ,,	Ditto ,,	
					Sasi Bhusan Banerji, Officiating Assistant Observer	Ditto ,,	Dttto ,,	
Agra	Ditto	Dr. A. H. Hilson	Ditto ,,	Ditto ,,	Mir Altaf Ali, Observer	Ditto ,,	23rd April 1882.	
					Syed Aziz-ud-din, Officiating Observer	24th April ,,	23rd July ,,	
					Mir Altaf Ali, Observer	24th July ,,	31st March 1883.	
					Abdul Majid Khan, Assistant Observer	1st April ,,	Ditto ,,	
Lucknow	Ditto	Dr. J. C. Whishaw	Ditto ,,	6th August 1882	Chotay Lal, Observer	Ditto ,,	Ditto ,,	
		Dr. J. Cameron	7th Aug. ,,	16th Sept ,,	Durga Parshad, Assistant Observer	Ditto ,,	Ditto ,,	
		Dr. J. C. Whishaw	17th Sept. ,,	31st March 1883.				
Roorkee	Ditto	Dr. Murray Thomson	1st April ,,	4th April 1882	Chiranji Lal, Observer	Ditto ,,	Ditto ,,	
		Lieutenant G. Onslow, R.E.	5th ,, ,,	7th July ,,				
		Dr. Murray Thomson	8th July ,,	31st March 1883	Tulsi Ram, Assistant Observer	Ditto ,,	Ditto ,,	
Jeypore	First	Dr. T. H. Hendley	1st April ,,	Ditto ,,	Durga Parshad, Observer	Ditto ,,	Ditto ,,	
					Gunga Ram, Assistant Observer	Ditto ,,	Ditto ,,	
					Nathu Narain, ditto	Ditto ,,	Ditto ,,	
Chakrata	Third	Captain A. E. Ward	Ditto ,,	Ditto ,,	Saligram	Ditto ,,	Ditto ,,	
Pauri	Ditto	Revd. J. T. McMahon	Ditto ,,	Ditto ,,	Revd. F. W. Greenold	Ditto ,,	20th Dec. 1882.	
					E. Thomson	21st Dec. ,,	21st Jan. 1883.	
					Revd. F. W. Greenold	22nd Jan. 1883	31st March ,,	
Pithoragarh	Ditto	Revd. Dr. R. Gray	Ditto ,,	Ditto ,,	Sher Singh	1st April 1882	4th June 1882.	
					Revd. Dr. R. Gray	5th June ,,	5th July ,,	
					Sher Singh	6th ,, ,,	31st March 1883.	

Names of the Superintendents and of the Observers at the Meteorological Observatories in North-Western Provinces and Oudh during the year 1882-83—(continued).

Observatory.	Class.	Officer in charge.	Date. From	Date. To	Observers.	Date. From	Date. To	Remarks.
Ranikhet	Third	No Superintendent	.....	.....	Jewa Nand	1st April 1882.	31st March 1883.	
Dehra	Ditto	J. B. N. Hennessey, Esq.	1st April 1882	31st March 1883	The Head Computers	Djtto ,,	Ditto ,,	
Meerut	Ditto	Dr. W. P. Harris	Ditto ,,	4th July 1882	Harsaran Das	Ditto ,,	Ditto ,,	
		Dr. G. S. Robertson	4th July ,,	10th Sept. ,,				
		Dr. L. A. Waddell	11th Sept. ,,	26th ,, ,,				
		Dr. G. S. Robertson	27th ,, ,,	1st October ,,				
		Dr. M. O. Dwyer	2nd Oct. ,,	10th Nov. ,,				
		Dr. G. S. Robertson	11th Nov. ,,	2nd March 1883.				
		Dr. W. Moir	3rd March 1883	31st ,, ,,				
Bareilly	Ditto	E. A. Phillips, Esq.	1st April 1882	17th May 1882	Jawla Parshad	1st April 1882	20th Nov. 1882.	
		No Superintendent	18th May ,,	30th June ,,	Sundar Lal	21st Nov. ,,	31st Jan. 1883.	
		E. A. Phillips, Esq.	1st July ,,	31st March 1883	Jawla Parshad	1st Feb. 1883	31st March ,,	
Gorakhpur	Ditto	Dr. C. Prentis	1st April ,,	Ditto ,,	Nizam-ud-din	1st April 1882	Ditto ,,	
Benares	Ditto	Dr. G. Thibout	Ditto ,,	Ditto ,,	Devakinandan Pathak	Ditto ,,	Ditto ,,	
Ghazipur	Ditto	Dr. P. A. Weir	Ditto ,,	Ditto ,,	Babu Kunjan	Ditto ,,	Ditto ,,	
Sutna	Ditto	Surgeon S. J. Goldsmith	Ditto ,,	17th April 1882	Har Nath	Ditto ,,	8th Feb. ,,	
					Ram Sahai	9th Feb. 1883	13th Feb. ,,	
		Surgeon C. G. W. Rodwell	18th ,, ,,	31st March 1883	Har Nath	14th ,, ,,	31st March ,,	
Nowgong	Ditto	J. Mather, Esq.	1st ,, ,,	3rd June 1882				
		Roshan Lal	4th June ,,	8th Aug. ,,	Karim Baksh	1st April 1882	30th June 1882.	
					Mannu Singh	1st July ,,	31st Aug. ,,	
		A. P. Mitchell, Esq.	9th Aug. ,,	31st March 1883	Baldeo Singh	1st Sept. ,,	31st March 1883.	
Sambhar	Ditto	W. Lyon, Esq.	1st April ,,	31st Aug. 1882				
		W. Poulter, Esq.	1st Sept. ,,	31st March 1883	J. Romare	1st April ,,	Ditto ,,	
Jhansi	Ditto	Surgeon G. M. Nixon	1st April ,,	25th Oct. 1882	Kalka Dass	Ditto ,,	Ditto ,,	
		Surgeon-Major L. E. Eades	26th Oct. ,,	31st March 1883.				
Ajmere	Ditto	Dr. J. H. Newman	1st April ,,	Ditto ,,	Ram Parshad	Ditto ,,	Ditto ,,	

APPENDIX B. IV.

Return of Instruments broken or otherwise injured at the Observatories in N.-W. P. and Oudh during the year 1882-83.

Station.	Grass radiation thermometer.	Solar radiation thermometer.	Maximum thermometer (for shade).	Wet minimum thermometer.	Anemometer.	Remarks.
Roorkee	1	...	...	...	...	
Meerut	1	...	...	1	...	
Agra	*2	...	...	...	...	* One of the instruments broken in transit.
Allahabad (old) Observatory	1	...	...	...	...	
Gorakhpur	...	...	...	1	...	
Benares	...	...	‡1	...	†1	† Teeth of the instrument worn out. ‡ Stolen.
Nowgong	1	1	...	...	...	
Sambhar	...	1	...	...	...	

APPENDIX B. V.

Comparison of Shade Temperature at the new Observatory, Muir College, Allahabad, with those simultaneously recorded at the old site.

Month.	Mean temperature.[1]			Mean at 10 A.M.			Mean at 4 P.M.			Mean maxima.			Mean minima.			Mean daily range.		
	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.
May 1882	90·1	90·5	−0·4	94·0	95·1	−1·1	101·5	101·9	−0·4	103·4	104·4	−1·0	77·3	76·9	+0·4	26·5	27·5	−1·0
June ,,	87·8	87·6	+0·2	89·4	89·5	−0·1	94·5	93·8	+0·7	96·1	95·7	+0·4	80·4	80·5	−0·1	15·7	15·2	+0·5
July ,,	83·7	83·5	+0·2	85·8	85·4	+0·4	87·2	86·9	+0·3	90·7	90·1	+0·6	78·6	78·9	−0·3	12·1	11·2	+0·9
August ,,	83·2	83·0	+0·2	85·0	84·9	+0·1	87·6	86·9	+0·7	91·1	90·4	+0·7	78·6	78·7	−0·1	12·4	11·7	+0·7
September ,,	84·0	82·8	+1·2	87·0	86·2	+0·8	90·6	88·6	+2·0	93·3	91·8	+1·5	77·0	76·6	+0·4	16·3	15·2	+1·1
October ,,	77·5	75·9	+1·6	83·0	80·8	+2·2	89·2	86·2	+3·0	91·0	88·9	+2·1	66·8	66·6	+0·2	24·2	22.3	+1·9
November ,,	66·2	64·7	+1·5	73·3	70·5	+2·8	79·3	76·0	+3·3	81·4	79·5	+1·9	53·5	54·4	−0·9	27·9	25·1	+2·8
December ,,	61·4	59·9	+1·5	62·6	65·1	+2·5	76·8	73·3	+3.5	78·8	76·7	+2·1	47·3	48·2	−0.9	31·5	28·5	+3·0
January 1883	61·1	60·1	+1·0	64·7	63·0	+1·7	71·7	69·7	+2·0	73·1	72·1	+1·0	48·6	49·4	−0·8	24·5	22·7	+1·8
February ,,	62·8	61·7	+1·1	66·5	64·8	+1·7	75·8	74·3	+1·5	78·0	76·4	+1·6	47·9	47·9	0·0	30·1	28·5	+1·6
March ,,	76·9	76·0	+0·9	81·4	80·6	+0·8	89·7	88·5	+1·2	90·8	90·3	+0·5	61·3	60·7	+0·6	29·5	29·6	−0·1
April (1st—15th 1883 / 16th—30th 1882)	89·2	89·7	−0·5	95·3	95·8	−0·5	102·6	102·5	+0·1	103·2	104·8	−1·6	71·5	70·8	+0·7	32·8	34·0	−1·2
Year	77·0	76·3	+0·7	81·1	80·1	+1·0	87·2	85·7	+1·5	89·2	88·4	+0·8	65·7	65·8	−0·1	23·6	22·6	+1·0

[1] Computed from the 10 A.M., 4 P.M., and Minimum readings by means of range factors founded on the hourly observations of several years.

APPENDIX B. VI.

Comparative Observations of Atmospheric Humidity at the old and new Observatories, Allahabad.

Month.	Vapour tension in inches of mercury.						Relative Humidity or percentage of saturaton.					
	Mean.[1]			At 10 A.M.			Mean.[1]			At 10 A.M.		
	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.	New.	Old.	Diff.
May 1882	·444	·458	—·014	·466	·490	—·024	33	35	—2	29	32	—3
June ,,	·804	·834	—·030	·824	·847	—·023	62	67	—5	59	65	—6
July ,,	·935	·956	—·021	·951	·983	—·032	81	83	—2	77	81	—4
August ,,	·878	·911	—·033	·893	·941	—·048	77	80	—3	74	78	—4
September ,,	·815	·858	—·043	·840	·892	—·052	70	75	—5	66	72	—6
October ,,	·578	·621	—·043	·596	·631	—·035	60	67	—7	53	59	—6
November ,,	·364	·418	—·054	·377	·418	—·041	58	66	—8	48	57	—9
December ,,	·306	·334	—·028	·317	·343	—·026	57	62	—5	46	55	—9
January 1883	·354	·367	—·013	·372	·381	—·009	68	71	—3	60	66	—6
February ,,	·276	·288	—·012	·277	·288	—·011	53	56	—3	43	47	—4
March ,,	·334	·341	—·007	·350	·346	+·004	42	43	—1	35	36	—1
April 1st—15th 1883, 16th—30th 1882	·306	·343	—·037	·314	·360	—·046	26	29	—3	15	22	—7
Year	·533	·561	—·028	·548	·577	—·029	57	61	—4	50	56	—6

[1] Crude mean of the 10 A.M., 4 P.M., and minimum observations.

APPENDIX B. VII.

Comparison of Sunshine and Cloud Observations at Allahabad.

Month.	Duration of bright sunshine in hours.	Number of hours during which the sun was above the horizon.	Percentage of bright sunshine.	Percentage of cloud at 10 A.M. and 4 P.M.	Percentage of clear sky.	Remarks.
April 1882	334·01	378·96	88·2	10·8	89·2	
May ,,	322·40	410·43	78·6	19·4	80·6	
June ,,	218·65	406·97	53·8	57·0	43·0	
July ,,	181·07	416·12	43·5	77·1	22·9	
August ,,	144·76	400·02	36·2	81·4	18·6	
September ,,	251·92	365·71	68·8	50·2	49·8	
October ,,	*295·81	*331·81	89·4	18·6	81·4	*2 days wanting.
November ,,	268·33	323·81	82·9	21·2	78·8	
December ,,	†282·61	†313·26	90·2	3·5	96·5	†1 day wanting.
January 1883	258·63	328·89	78·7	26·6	73·4	
February ,,	272·91	312·39	87·4	27·5	72·5	
March ,,	305·91	368·13	83·1	27·1	72·9	
Year	3,137·01	4,356·50	73·4	35·0	65·0	

APPENDIX C.

Administration Report of the Meteorological Reporter to the Punjab Government for 1882-83.

During the year 1882-83, the work of the Meteorological Department, Punjab, excepting that of sending telegrams, was carried on in the same manner as last year; no new observatories were established, nor were any of the old ones suppressed; there were thus, as before, twelve observatories under this office. Two of them are 2nd class and ten 3rd class.

The year under report showed considerable improvement in the character of work of all the observatories under my charge, and I have little or no complaint against any of the observers. The only observatory where many mistakes occurred was Rawalpindi; but on the whole the registers received from the observers throughout the province were superior to those of former years.

2. The work ot the office has greatly increased. Besides the regular routine work of correcting and reducing the meteorological observations recorded at twelve stations, this office has to make annual report of the climate of the Punjab for the Local Government, and monthly abstract sheets for the Sanitary Commissioner for Punjab, a copy of which is always forwarded to the Meteorological Reporter, India.

3. With this increase of work the amount of correspondence has more than kept pace, so that the number of letters sent out has doubled during the last three years.

4. Most of the observers in the Punjab retained the meritorious allowances granted to them last year during the current. Three more meritorious allowances were granted for 1883-84 to Jasput Rai, Divan Chand, and Mr. Cruickshank on account of the generally good character of their work. The observatories inspected during the year were as follows:—*Simla, Delhi, Ludhiana, Rawalpindi, Murree*, and *Dera Ismail Khan*. All of them were found in satisfactory order; two of the observatories, Murree and Dera Ismail Khan, were supplied with new barometers at the time of inspection.

5. The observatory at Lahore still works as 2nd class observatory; though it is under my superintendence, it is in immediate charge of the chief observer here, Jasput Rai, and is always in first rate order.

6. The work of inspection was unfortunately incomplete during the year under report, owing to my duties in the medical school. I am never able to leave the station in the cold weather, and last year the only time I could get away to visit the observatories was in the middle of September. On reaching Rawalpindi on my way to Peshawar, I found the line between *Pindi* and *Attock* was impassable owing to heavy floods, and after inspecting Murree I was obliged to return to Lahore and was unable to leave head-quarters again afterwards. As in former years, I found generally at the observatories, which I inspected, that the work of the observers is not performed by the men who are paid for it; at Delhi my friend Dr. Ross, the Civil Surgeon, has informed me that the Assistant Surgeon who draws the pay has taught and pays the dispensary clerk to take the observations, and I believe this is the rule in most of the other observatories, where the observers are Assistant Surgeons, though they have not always the honesty to confess it. At the request of Dr. Ross, the dispensary clerk will be appointed to take the meteorological observations at Dehli during the ensuing year; and if he does the work well, the same plan will be introduced in other observatories. The monthly pay of Rs. 15 is not sufficient to induce men of the Assistant-Surgeon class to do the meteorological work properly. But it is a very considerable sum to their subordinates, who are moreover constantly on the spot and more amenable to the authority of the Superintendents of the observatories, and therefore this plan ought to work well.

7. The most important work in connection with the observatories is that of inspection. I should like to make my chief observer in Lahore, who is a reliable man, travel about inspecting the observa-

tories frequently throughout the year. This would add very little to the expense of the Department, while it would add very largely to its efficiency.

8. Specified tables for the instruments issued and broken,[1] and observers and Superintendents of the observatories (C II), are herewith appended.

E. LAWRIE, M.B.,
Meteorological Reporter for Punjab.

LAHORE;
The 15th June 1883.

[1] This list has been inserted in the general list, Appendix I.

APPENDIX C. II.

Table showing the Names of the Superintendents and Observers at the Meteorological Observatories in the Province of Punjab during the year 1882-83.

No.	Observatories.	Class.	Names of Superintendents.	Period. From	Period. To	Names of Observers.	Period. From	Period. To	Allowances. Monthly allowances.	Allowances. Meritorious allowances.
1	LAHORE	II	Dr. E. Lawrie, M.B., Meteorological Reporter for Punjab	Throughout		Babu Jasput Rai, Chief Observer, and Divan Chand, Assistant	Throughout		20 10	5 5
2	DELHI	III	G. Ross, Surgeon-Major	Ditto		Asst.-Surgeon Ramkishen Asst.-Surgeon Gokul Chand Asst.-Surgeon Ramkishen	1st April 1882 8th Nov. 28th March	7th Nov. 1882 27th Mar. 1883 31st March	15	...
3	LUDHIANA	III	Brigade Surgeon R. Rouse	Ditto		Bhugwan Das Heera Lal Chatterji Bhugwan Das	1st April 13th Augt. 5th Oct.	12th August 4th Oct. 31st March	15	...
4	MULTAN	III	Surgeon M. R. Gray Asst.-Surgeon Jaswant Rai S. M. W. Jackson S. M. J. Bennet	1st April 10th April 24th April 16th Jany.	9th April 23rd April 15th Jany. 31st March	Mir Wahid Ali	Throughout		15	...
5	DERAH ISMAIL KHAN	III	Dr. T. Robinson, M.B. Dr. Ped. H. Haig Dr. A. W. Mackenzie Dr. Hde. H. Haig	1st April 1882 25th July 1882 28th July ,, 30th Oct.	24th July 1882 27th July 1882 29th Oct. 31st March	Noor Bukhsh	Ditto		15	...
6	SIRSA	III	Dr. R. Crossby A. Sobha Ram R. Crossby	1st April 27th Feby. 13th March	26th Feb. 12th March 31st March	Hospital Assistant. Fazaloor Rahman Sham Sunder	1st April	16th Mar. 1883	15	5
7	SIALKOT	III	Thomas S. Veal	Throughout		Asst.-Surgeon Fatteh Singh Sardar Khan Fatteh Singh	1st April 4th July 11th Sept.	3rd July 10th Sept. 31st March	15	
8	MURREE	III	Revd. G. C. Peak	Ditto		Mr. W. Cruickshank	Throughout		15	5
9	SIMLA	III	Quarter-Master General, India	Ditto		J. W. Peart	Ditto		15	
10	PESHAWAR	III	S. W. Coates	Ditto		Kashi Ram Sita Ram Kashi Ram	1st April 1st August 1st Nov.	31st July 31st Oct. 31st March	15	5
11	LEH	II	N. Elias, Joint British Commissioner	.....	.....	Hira Lal Ramzan Bukhsh Lassgass Bholanath, Assistant	1st April 23rd Sept. 1st Nov.	22nd Sept. 31st Oct. 31st March	20*	5[1]
12	RAWALPINDI	III	S. M. G. Massay Dr. T. R. Malrony S. M. G. Massay	1st April 16th July 16th August	15th July 15th August 31st March	Asst.-Surgeon Jaggan Nath Asst.-Surgeon Bhugwan Das	Throughout 1st April 12th Nov.	11th Nov. 31st Mar. 1883	15 15	5

[1] Rupees 5 meritorious allowance were only given to Hira Lal on account of his being very punctual to his duty of observations.

LAHORE:
The 15th April 1883.

E. LAWRIE, M.B.,
Meteorological Reporter to the Govt. of Punjab.

APPENDIX D.

Extracts from the Administration Report of the Sanitary Commissioner, Central Provinces.

I have the honour to forward the Meteorological Report of the Central Provinces for the year ending 31st March, as called for in your letter of 8th March 1883.

2. I have not myself inspected any of the observatories, as I took charge on the 2nd April 1883.

3. There are in the Central Provinces three 2nd class observatories—

Nagpur,
Jubbulpore,
Pachmarhi,

and eight 3rd class observatories—

Chanda,
Saugor,
Seoni,
Hoshangabad,
Khandwa,
Raipur,
Sambalpur,
Sironcha.

4. Nagpur.—The Superintendent reports that the shed was damaged by a storm; also that the observer, Alligherry Swamy, has been rewarded by a grant of Rs. 10 per mensem extra pay since April 1882.

5. Jubbulpore.—The Superintendent reports that no definite orders have as yet been received regarding the erection of the proposed new thermometer shed in the civil dispensary compound, also that no orders have been received regarding the transference of the anemograph from the dispensary tower to the jail tower. The observatory has got two new instruments. Solar radiation thermometer in use since 7th February, and anemoscope in use since 18th March. The Superintendent regrets that he has to report that the observer is wanting in punctuality.

6. Pachmarhi.—The Superintendent reports that the barometer was removed into the room for anemograph on 1st September.

The observer's conduct and qualifications are good.

7. Chanda.—The Superintendent reports that two new instruments were received, one instrument was broken.

The observer's conduct and qualifications are good.

8. Saugor.—The Superintendent reports that no instruments were received or broken.

The observer's conduct and qualifications are good.

9. Seoni.—The Superintendent reports that no instruments were received or broken.

The observer is very favourably reported on by the Superintendent and has been promoted from 1st April 1883.

10. Hoshangabad.—The Superintendent reports that a barometer on the Kew principle has been received to replace a mountain barometer which got out of order and was returned to the Meteorological Reporter's office. Also a new solar radiation thermometer to replace one broken. The old solar radiation thermometer is supposed by the Superintendent to have been maliciously broken,—*vide* his letters of 5th and 15th August 1882.

The conduct and qualifications of the observer are good.

* * * * *

11. Khandwa (Nimar).—The Superintendent reports that no instruments have been received or broken.

The conduct and qualifications of observer are good.

12. Raipur.—The Superintendent reports that a fence has been put up round the shed to prevent cattle trespassing.

A new barometer on Fortin's principle was received, and brought into use on 16th June 1882.

A new grass radiation thermometer was brought into use on 9th March. Advice was received on 20th March of the despatch of a new solar radiation thermometer.

One instrument was broken—a solar radiation thermometer. The accident occurred on 7th March owing to a severe hail-storm, which came on very suddenly.

The Superintendent reports very favourably of the observer's conduct and qualifications and recommends his promotion.

13. Sambalpur.—The following instruments have been received :—

Hygrometer, maximum thermometer, dry minimum, wet minimum, grass radiation and solar radiation thermometers, rain gauge 5 inches and measure glass, sun thermometer stand, pad for grass radiation thermometer, and thermometer cage.

No instruments have been broken during the year.

The observer's conduct and qualifications are good.

The Superintendent recommends that the enclosure should be surrounded with large mesh wire fencing instead of the present enclosure of wooden posts and bamboos which he says hardly lasts one season.

14. Sironcha.—A new thatch was put over the observatory shed, and the ladder leading to the anemometer was repaired at an expense of Rs. 30 sanctioned for the same.

No new instruments were received. The time-piece got out of order on the 4th July and was sent to Nagpur to the Sanitary Commissioner's office for repairs.

* * * * *

The observer, Hospital Assistant T. Muthoo Krishna Naidu, is favourably reported on by the Superintendent, Haran Chunder Dutt, Assistant Surgeon in medical charge of the Sironcha station.

15. The sub-division of Sironcha has been abolished with effect from 1st April 1883, and there will not in future be any Assistant Surgeon posted there. On the 2nd April 1883, Dr. Simpson, Deputy Surgeon-General, recommended that the tahsildar of Sironcha should be appointed Superintendent of the observatory. This has been sanctioned by the Chief Commissioner, Central Provinces, in letter No. 1492-79 of 10th April 1883.

W. WATSON, M.D.,

Offg. Deputy Surgeon-General and
Sanitary Commr., Central Provinces.

APPENDIX D. II.

Names of the Superintendents and Observers at the Meteorological Observatories in the Central Provinces during the year 1882-83.

Observatory.	Class.	Officer in charge.	Date. From	Date. To	Observers.	Date. From	Date. To	Remarks.
					T. V. Allagheri Swamy	1st April 1882	8th Sept. 1882	On 6 months' leave on private affairs.
					T. Soobiah	9th Sept. ,,	8th Mar. 1883	
					T. V. Allagheri Swamy	9th Mar. 1883	31st Mar. ,,	
Nagpur	Second	Surgeon-Major R. T. Wright, M.D.	1st April 1882	31st Mar. 1883				
					Assistant Observers.			
					T. Soobiah	1st April 1882	8th Sept. 1882	
					T. Ramchurn	9th Sept. ,,	8th Mar. 1883	
					T. Soobiah	9th Mar. 1883	31st Mar. ,,	
					Bani Kanta Ray Chowdhri	1st April 1882	30th June 1882	
					Pandit Saduram Dubay	1st July ,,	31st Mar. 1883	
Jubbulpore	Ditto	Surgeon-Major W. R. Rice, M.D.	1st April 1883	31st Mar. ,,				
					Assistant Observer.			
					Hospital Assistant Kunj Behari Lal	1st April ,,	31st Mar. ,,	
					Madho Rao	1st April ,,	31st Mar. ,,	
		R. H. Finch, Esq.	1st April 1882	14th May 1882				
		A. C. Duff, Esq.	15th May ,,	16th June ,,				
Pachmarhi	Ditto	F. A. T. Phillips, Esq.	17th June ,,	17th Jan. 1883				
		A. C. Duff, Esq.	18th Jan. 1883	31st Mar. ,,				
					Assistant Observers.			
					Narain Bhagwant	1st April ,,	16th Nov. 1882	
					Kesho Rao	17th Nov. ,,	31st Mar. 1883	
Saugor	Third	Surgeon-Major J. W. Strong	1st April 1882	31st ,, ,,	Deendyal Pathuck	1st April ,,	4th June 1882	
					Sado Rao Pathuck	19th Oct. ,,	31st Mar. 1883	
Hoshangabad	Ditto	Surgeon S. H. Browne, M.D.	1st ,, ,,	31st ,, ,,	Jadu Nath Bose	1st April ,,	31st Mar. ,,	
Khandwa	Ditto	Surgeon-Major P. Cullen, M.D.	1st ,, ,,	31st ,, ,,	Behari Lal Parasar	1st April ,,	31st Mar. ,,	
Seoni	Ditto	,, J. B. Gaffney	1st ,, ,,	31st ,, ,,	Punchum	1st April ,,	31st Mar. ,,	
		Surgeon H. Armstrong	1st ,, ,,	17th July 1882				
Chanda	Ditto	Asst. Surgeon Omesh Chunder Mitter	18th July ,,	17th Oct. ,,	Seetaram	1st April ,,	31st Mar. ,,	
		Surgeon H. Armstrong	18th Oct. ,,	31st Mar. 1883				
Sironcha	Ditto	Haran Chunder Dutt	1st April ,,	31st ,, ,,	Haran Chunder Dutt	1st April ,,	9th May 1882	
					T. Muthu Krishna Naidu	10th May ,,	31st Mar. 1883	
Raipur	Ditto	Surgeon-Major D. W. Trimnell	1st ,, ,,	31st ,, ,,	Krishna Rao	1st April ,,	31st Mar. ,,	
Sambalpur	Ditto	Honorary Surgeon J. E. Harrison	1st ,, ,,	31st ,, ,,	Babu Sham Soondur Das	1st April ,,	31st Mar. ,,	

APPENDIX D. III.

Notes on the Inspection of Observatories in the Central Provinces.

Khandwa twice inspected—last rains, and in March 1883.

A new shed is being sanctioned with wire fencing and stone posts. The old structure is in a very rickety condition, and may at any time come to grief; all instruments in order.

A new barometer room close to the shed is being built.

Jubbulpore.—Inspected in November last. The anemograph had been erected on the tower of the main dispensary. Site good, but instrument would not work owing to increased length of chain rendered necessary by distance between the instrument and the table. I arranged to have it erected on one of the jail towers.

All the instruments in good order and clean. Pluviometer, however, is not the right height from the ground.

I observed that the cup of water for feeding the wet bulb was suspended above the bulb instead of below it as ordered. Dr. Rice and the observer both assured me that they found if this were not done, the bulb could not be kept moist in the west (hot) winds. The water used is rain water, and the wick and the muslin were regularly changed. No other observer has found this difficulty. At Khandwa, where the hot winds blow with greater force than Jubbulpore, it is not observed. So it is difficult to account for, except on the supposition that the muslin is tied too tight.

Seoni.—Everything was found in order at my inspection in November. Instruments clean and books well kept. The observer here was passed over by Mr. Blanford (see correspondence), but has been recommended by me for promotion this year.

Nagpur.—Everything in order. I inspected this observatory on 15th May last.

Sambalpur.—The observatory shed (eaves too low, 3 feet 5 inches) is being removed, as the extensions to the jail will encroach on it.

The barometer was kept in the jail, and this was objected to by the Superintendent on the ground of its being inconvenient to allow the observer access at all hours. An old magazine is now being turned into a barometer room. The instrument I found badly placed, (light coming from behind), and not high enough from the ground. It is an old mountain barometer. The mercury was much oxidized. I took it out, filtered it, and cleaned the cistern.

The anemometer did not work properly, owing chiefly, I think, to its being loose. I remedied this, and I understand it works well now.

The pluviometer was not at the right height from the ground. Measurements showed it to be 15½ inches.

Arrangements for grass radiation thermometer defective. Cloth pad hardly necessary in Sambulpur.

Raipur.—Instruments in good order except barometer, the mercury of which was so much oxidized that I had to clean it.

Chanda.—Position of wind vane very objectionable, surrounded by high trees on three sides. Instruments in good order; barometer not the proper height from ground,—too low.

Sun radiation thermometer has ½ degree of mercury fixed in end of tube. This has not been allowed for in the observations.

B. SIMPSON, M.D.,
Deputy Surgeon-General and Sanitary Commissioner, Central Provinces.

APPENDIX E.

List showing the names of the Superintendents and Observers at the Meteorological Observatories, reporting immediately to the office of the Meteorological Reporter to the Government of India during the year 1882-83.

Observatories.	Class.	Names of Superintendents.	Period. From	Period. To	Names of Observers.	Period. From	Period. To
Aden	3rd	Major F. M. Hunter	1st April 1882	27th June 1882	Mr. D. C. Coutinho	1st April 1882	31st Mar. 1883.
		Captain C. W. H. Sealy	28th June ,,	21st Sept ,,	Shaik Ebrahim	1st April ,,	31st Mar. ,,
		Major F. M. Hunter	22nd Sept. ,,	10th Dec. ,,			
		Captain C. W. H. Sealy	11th Dec. ,,	31st Mar. 1883			
Bushire	3rd	.....	.....	.....	Not known	1st April ,,	31st Mar. ,,
Quetta	3rd	J. C. Fullerton, M.B.	1st April 1882	31st Mar. 1883	A. Samuel Pillay	1st April ,,	31st Mar. ,,
Pachbudra	3rd	Mr. A. R. Shaw	1st April ,,	26th Jan. ,,	Babu Birdhi Chund	1st April ,,	30th Sept. 1882.
		Mr. G. A. Bradford	27th Jan. 1883	31st Mar. ,,	Mr. P. Holder	1st Oct. ,,	31st Mar. 1883.
Mussooree	3rd	Father Genesius	1st April 1882	30th Sept. 1882	Brother Joseph	1st April ,,	31st Mar. ,,
		Father Lawrence McCarthy	1st Oct. ,,	31st Mar. 1883			
Katmandu	3rd	.....	.....	.....	Pashuput Sharan Sinha	1st April ,,	31st Aug. 1882.
					Mohamad Hossain	1st Sept. ,,	31st Jan. 1883.
					Pashuput Sharan Sinha	1st Feb. 1883	9th Mar. ,,
					Mohamad Hossain	10th Mar. ,,	31st Mar. ,,
Mongpoo	4th	.....	.....	.....	George A. Gammie	1st April 1882	31st Mar. ,,
Makhla	4th	J. Balantine, Esq.	1st April 1882	31st Mar. 1883	Kuarsing	1st April ,,	9th June 1882.
					Jagmohan	10th June ,,	11th July ,,
					Kuarsing	12th July ,,	31st Mar. 1883.
Diamond Island	3rd	.....	.....	.....	T. N. Marsh	1st April ,,	31st Mar. ,,
Port Blair	3rd	Surgeon-Major J. Reid, M.B.	1st April 1882	31st Mar. 1883	J. T. Peters	1st April ,,	31st Mar. ,,
Nancowry	3rd	.....	.....	.....	S. Thomas	1st April ,,	13th July 1882.
					Shaik Kabeerooddeen	14th July ,,	30th Dec. ,,
					Shaik Abdool Wahad	31st Dec. ,,	31st Mar. 1883.

APPENDIX F.

Extracts from the Report on the Administration of the Meteorological Department in Western India during the year 1882-83.

The work of the Meteorological Department in Western India during the past official year has been carried on much as usual, attention having been given mainly to securing uninterrupted records of trustworthy and comparable observations at the second and third class stations. A healthy ambition to do good work has been created amongst the observers by the grant, since April 1882, of good work allowances; and it seems likely that by this means the character of the observations will in many cases be improved. At those stations where soldiers were employed as observers, interruptions in the registers were constantly liable to occur, owing to the soldiers being summarily called away for military duty. To remove this liability, the soldiers have been replaced by civilians, who are subordinates of the Meteorological Department only. The storm-warning system has been carried on the same as in the previous year. Mr. F. Chambers, the permanent incumbent of the office of Meteorological Reporter for Western India, has been absent in England for ten months during the past year, and his place has been occupied during six weeks by Surgeon-Major W. Nolan, M.D., B.Sc., and during the remaining time by myself.

Observatories.

The number of observatories remains the same as in last year, namely, four second class, eighteen third class, and one voluntary. Calicut has received a maximum and a minimum thermometer, and has thus, been placed on the same footing as the third class observatories. An application has been received from Mr. K. M. Joglekar, M.A., head-master of the Sirdar High School at Baroda, for permission to establish an observatory on the voluntary system at that station; and as the conditions of site and probable permanency appear favourable, the application is being forwarded. Besides the above observatories, there are over four hundred raingauge stations, which forward their returns regularly to this office. The list of observatories and the names of the Superintendents and the observers are given in the Appendix F II.

Inspection of Observatories.

During the cold season, (including the first week in April 1883,) I visited sixteen stations, namely, Surat, Rajkot, Deesa, Mount Abu, Neemuch, Indore, Malegaon, Kurrachee, Hyderabad (Sind), Jacobabad, Amraoti, Poona, Sholapur, Ratnagiri, Belgaum, and Goa.

Surat.—There are two observatories here, one at the camp, 3 miles out of the town, where the barometer, thermometers, and raingauge are situated; and one at the castle in the town, where the anemometer is fixed. At the camp, the instruments were in good order; but the enclosure for the grass thermometer had been covered over by wire netting in order to prevent damage to the instrument through exposure to night birds and beasts; this has since been removed. The thatch of the thermometer shed required repairing. At the castle, the observer was one who had been trained ten months previously by the former observer, and as seems to be common in such cases, his work was defective. I taught him the method of reading the instrument, and of telegraphing the wind velocity, and at the same time showed him how to clean the instrument; the dial plate had been polished up with bath-brick, but the working parts left full of dust and sand. The observer at the camp complained of the want of a sufficient allowance for a messenger to take the daily telegrams to the telegraph office, which is situated 4 miles from the observatory, and I think he might be allowed Rs. 4 a month for a peon. It seems likely that in the course of only a few years the two companies of Native Infantry stationed here may be withdrawn altogether; and if this should occur, it will then be necessary to make some other provision for carrying on the meteorological work; it might therefore be possible to remove the observatory nearer to the telegraph office. With this prospect in view, I examined the position of the telegraph office and also the civil hospital; but as these are in the heart of the town, whereas the camp is in the open country, the meteoro-

logical conditions of the two former sites are likely to be so different from what they are at the latter, and moreover so little representative of the country about, that I should be prepared to recommend the establishment of a permanent observer at the present site, rather than the removal of the observatory.

Rajkot.—The instruments here were all in good order, excepting the anemometer, the pipe of which had been cut down so that the box of the anemometer rested directly upon the wooden cross-piece to which it was fixed. This had been done because the observer found the dial plate too high to be conveniently read. A fresh piece of pipe has since been supplied, and the anemometer refixed at the standard heigth above its support. The observer here made the mistake of taking observations by Madras instead of local time. During the year 1881-82, there were two long interruptions in the work of the observatory at this station, and it was, therefore, considered desirable to inquire into the possibility of removing the instruments to the neighbourhood of the telegraph office and appointing the telegraph master meteorological observer. I therefore visited the telegraph office and found the telegraph master, Mr. W. G. Harvey, willing to undertake the work. There is open ground on the west side of the telegraph compound, which would be suitable for the thermometers, &c., and the anemometer could be fixed at the top of a wooden pillar on the roof of the telegraph office. The site here, however, is not quite so favourable as the present one, being somewhat more closed in; and as the present observer is doing his work well, and there is not much reason to suppose he will be suddenly called away, I have not considered it advisable to pursue the matter further.

Deesa.—The instruments here were in good order. The worm and worm-wheel of the direction vanes of the anemograph were clogged with stiff grease; this I recommended should be cleaned without stopping the instrument. The pin connecting the pendulum of the anemometer clock with the escapement was bent outwards, and rubbed against the clock case, so as to stop the clock if the case were put on. This I remedied, and also so bent the pin as to make the tick regular.

Mount Abu.—The instruments at this station were in good order, except that most of the thermometers required their graduation marks re-blackening; and that the outer bulb of the solar thermometer had a grey deposit inside. The barometers were hung in a dark corner of the office, These have subsequently, at my recommendation, been hung in the window recess, where there is a good light. Also the flagstaff and flag were too large, and seemed likely to interfere with the readings of the anemometer. These I recommended should be cut down in size and length. The observer, Bapalal Mehta, a writer in the military hospital, had been trained by the previous observer, corporal C. Barley. I examined him and found him to be painstaking and careful; but he made the mistake of taking the observations according to official instead of local time; and also in obtaining the number for accuracy in the daily telegrams had been in the habit of using the artificial barometric reading, as for instance 29·162 instead of the actual reading 26·162. These matters he has since attended to.

As there had been considerable interruptions in the records of this observatory, the advisability of removing the instruments to the neighbourhood of the telegraph office, and of appointing the telegraph master to be observer, had been considered; and I inspected the site of the telegraph office with this in view. It is not so suitable as the present site, being situated in a hollow and surrounded with trees. There is a rising piece of land at a short distance from the office just on the borders of and within the Resident's compound; and if no other site were available, this would have been the best in the neighbourhood. As however the present observer, Bapalal Mehta, is doing the work satisfactorily, and as he, not being a military man, is not likely to be removed from this station, it has not been necessary to take further steps in the matter.

Neemuch.—The instruments at this station were all in good condition, except the anemometer, which had been damaged by a fall during a high wind. The cups were bent out of shape. It has since been replaced by a new one, and has been recompared in Bombay, its factor now being 1·37 instead of 1·30 as formerly. The observer did not understand the use of the new eight-word telegraph code; this I explained to him, and his telegrams have since been made out more correctly. He also took observations by Madras time instead of local.

Indore.—The observer here, Trimbukrao, was not trained in Bombay, but by the former observer, Gunpat Singh. He is the store-keeper of the civil hospital. I examined him, and found him painstaking and his work fairly reliable; but in no case have I found men locally trained so sure in their work as those trained in Bombay. The anemometer, which is one of Robinson's five-wheeled instruments, is not well situated; it is fixed on the gable end of a building, on the same level as the ridge of the roof; and around this building there are trees, some of which are higher than the ridge of the roof. Moreover, there is a thick flagstaff rising up several feet above the anemometer and fixed close to it. It would be better if the anemometer were raised 8 or 10 feet above the ridge of the roof. But as it is probable that it has been fixed in this position for many years, I did not consider it advisable to make any alteration. The barometer also was badly placed, being hung from a projecting shelf, and having nothing but dark space behind it. I had sheets of white paper placed behind, in order to facilitate the reading. The other instruments were all in order, and the observer took the readings correctly by local time.

Malegaon.—The observer at this station, Anaji Pandurang, had been in Bombay some days for training, but had had to leave before he could get his certificate of competency. I examined him and found his work fairly accurate, but made his receiving a certificate of competency conditional upon the nature of his work during the next few months. He was, however, shortly ordered away and replaced by another man, Gopal Cuddum, whose work has not been uniformly satisfactory. The observer, Anaji Pandurang, took his observations by Madras time. The barometer was badly placed being hung from a screw fixed in a cupboard whose sides were slanting, and the barometer resting against the cupboard slanted with it. The thermometer graduation marks required re-blackening; and the thermometer shed admitted a little sunshine through the roof on the south side. I directed that the barometer should be hung vertically, and that the other matters should receive attention.

Kurrachee.—The instruments were all in good order. The military observer, private F. Bateman had been in the habit of counting the marks of the barometer vernier upwards from the bottom of the vernier, not from the lowest mark of the vernier. In most of the barometers the bottom of the vernier is intended to be counted as the lowest mark; this was the case in the barometer which the observer used during the course of his training in Bombay. But in the Kurrachee barometer there is a little extension of brass below the lowest graduation mark, in order to make that mark more distinct. This the observer had counted as an extra mark, so that his readings had been too high by the amount of one vernier graduation, that is by ·048 of an inch, and therefore from all his readings taken between 3rd January 1882 and 24th January 1883 this amount has been subtracted. After the latter date he read the barometer correctly.

It is under consideration to extend the building at the Napier Hospital, where the observatory is situated; and it may be necessary to remove the barometer and the thermometer shed. I therefore looked about for another possible site, and considered that in case it should be necessary to remove the instruments, the barometer might be placed inside the anemometer tower, and the thermometer erections placed about 200 feet to the west of the tower.

Hyderabad (*Sind*).—The instruments at the hospital were in good order, except that the dry and wet bulb thermometers had been screwed to the cross bar of the cage by means of iron screws which had become so rusted that it was impossible to remove them without risk of breaking the thermometers; this has since been remedied, the screws having been replaced by brass ones.

The anemometer is placed at the top of a tower, on the outer wall of the jail, about a mile from the hospital. The man who attended to it was not present, so that I could not examine the instrument nor explain the proper use of it to the observer, whose readings frequently appear doubtful.

Jacobabad.—I found 16° of spirit at the far end of the grass thermometer; but was unable to discover from what date this source of error had commenced. The present observer, Narayen Mane, formerly stationed at Bhuj, had taken charge only a short time before I visited the place. He said that the old observer, Karim Rajakhan, had been in the habit of reading the grass thermometer every morning without having placed it outside the previous evening; it remained in the office all night. The maximum thermometer slanted backwards so much that the detached portion of the column of

mercury ran back instead of registering the maximum temperature. This I remedied by placing the thermometer horizontal, but it appears to have gone wrong again, and has had to be replaced by another one. The anemometer had not been cleaned for many months. I took it down, and had it thoroughly cleaned. The rest of the instruments were in order.

Amraoti.—I visited this station at the request of Dr. T. Hume, the Superintendent of the observatory, whose office it was intended to have removed into another building, thus rendering it desirable that the observatory also should be removed. I examined the proposed new site and found it suitable. It is about half a mile to the west of the present site, on open ground about 300 or 400 feet to the north of the Lunatic Asylum. This Asylum consists of a series of low buildings, not likely to affect the meteorological conditions at that distance. There is a low hill in a south-westerly direction from the proposed site, but I think it is not near enough to materially affect the readings of the instruments. I proposed that, in the new observatory, the thermometer shed should be made according to the standard pattern, and that the anemometer should be placed upon a tower about 30 feet high instead of on a short post as it is at present. The proposed site is so similar to the present one that it may not be necessary to continue double observations for a whole year; but this can be ascertained only after a few months' trial. The instruments at this observatory were all in order except the anemometer, which frequently registered a calm when there was a perceptible breeze blowing. This was owing to the friction pellet at the bottom of the verticle spindle having been lost. Another pellet has since been supplied.

Yerrowda (Poona).—The instruments at this observatory were in good order and do not call for special remark except the anemometer. It is one of Casella's self-registering instruments. The ribbon of paper stuck between the velocity rollers, so that it was impossible to pull the paper through without tearing it. This I found to be caused by the brasses of the bearings of rollers being too tightly screwed down. The gearing below the velocity chain did not work smoothly. This I found to be due to the length of the chain, which allowed the teeth of the improved roller to catch in the teeth of a wheel underneath. This was remedied by having the table on which the recording apparatus was fixed planed down $\frac{1}{8}$th of an inch, and after this was done the instrument worked smoothly. It was also taken to pieces and thoroughly cleaned and oiled.

Sholapur.—Owing to the withdrawal of troops from this station, the regimental hospital is now deserted, and there is no longer work for a medical subordinate. It has therefore become necessary to make other arrangements for carrying on the observatory work. And I visited the place with the object of seeing what arrangements would be suitable and practicable. The present site is the best which could be obtained in the neighbourhood; but it requires the observer to be resident on the spot, or at least to spend a great part of his time there. The next best site is near the Government telegraph office, about half a mile to the south-east of the regimental hospital on slightly rising ground at the border of the maidan. The civil hospital is very unfavourably situated for observatory purposes. It has therefore been decided, with the concurrence of the telegraph authorities, to remove the observatory to the site of the telegraph office and appoint the telegraph master observer.

The present observer, who took over charge on the 26th December last, was not trained in Bombay, and as is generally the case in such instances, his work was defective. He appears to have seldom used the adjusting screw in reading the barometer, and the anemometer was very dirty, the glass face being so stuck with sand and stiff oil that it had to be broken to get it out. It is likely that before the barometer readings since the 26th December can be used for comparison with others, a correction for capacity will in some, if not all, instances have to be applied. The observer took the readings by what he called local time, but his clock was 30 minutes later than Madras time, so that the observations were taken by Bombay, not Sholapur, time, which is only about 18 minutes later than Madras.

Belgaum.—The instruments at this station were all in good order, except that the arrangement for lifting the pencils of the Robinson-Beckley anemograph worked very stiffly, so that when the lowering screw was turned to allow the pencils to fall, the pencils would not go down unless pressed with the hand. The effect of this was that the pencils did not always touch the paper,

and the trace was consequently not continuous. I took the instrument to pieces, discovered the cause of the stiffness, and remedied it, so that the traces now are continuous. In putting the instrument together again, I did not notice that the pin for marking the time on the paper was fixed 35 minutes behind the pencils. Until therefore this can be re-adjusted, 35 minutes will have to be subtracted from the time shown by both the pencils.

As the anemometer tower is situated about 1¼ miles from the thermometer shed, much inconvenience is experienced, especially in rainy weather, in passing between the two places, and this inconvenience is felt more considerably by the new civilian observer, who, owing to his not being a military subordinate, is not allowed to occupy any of the buildings near the observatory office. It would be very desirable to have all the observatory buildings compact and together; and as the anemometer tower stands on a very favourable site, I have taken steps to see if it would be practicable to have an office, thermometer shed, and observer's quarters built near to the tower.

Ratnagiri.—I found everything in order here. The tower for the new Casella's self-recording anemometer had been finished, and the instrument fixed in it. I examined the instrument to see that it was in order, placed the direction arrow true, and explained to the observer the method of reading the records. The tower is situated on a very favourable site, on high and open ground near the reservoir of the water-works at some distance inland from the cliff.

Goa.—I had arranged to inspect the observatory at Karwar, and after leaving Belgaum embarked in a pattymar from Vingorla with that object. But adverse winds and calms obliged me after being on the sea for 29 hours to put in at Goa. Whilst waiting there for the return steamer, I inspected the meteorological observatory. It is under the charge of Mr. A. F. Martins, a Professor in an educational institution there. The anemometer was fixed on a lamp post in front of a large military building on the quay. The wet and dry bulb, maximum, dry minimum, and wet minimum thermometers were hung on the wall inside the office. The sun and grass radiation thermometers were not used owing to the want of a proper place for them. There were two raingauges; one hung on a lamp post out side a garden wall, and not sufficiently removed from trees; and the other placed on the ground inside the garden, the exact position of which I did not see. Mr. Martins, whom I have to thank for his kindness in showing me all the arrangements, said that he had tried to have a proper observatory building erected, such as had been suggested by Mr. F. Chambers; but the expense had been an insurmountable obstacle. I suggested that the anemometer should be fixed at the top of a post on the roof of the military building, and that the same arrangements for the exposure of the thermometers and raingauge should be adopted as throughout British India. I forwarded a copy of the Indian Meteorologist's Vade Mecum, Part I, to Mr. Martins, and at his request I submitted my suggestions officially in writing; he thought it would be possible to have the suggested arrangements sanctioned.

The correction to the Bombay standard for the barometer at Goa, as ascertained by six readings, none of which varied by more than $\frac{1}{500}$th of an inch, was +·017. There were two thermometers which had Kew certificates. They were as follows:—

No. 29560.	°	No. 29561.	°
32°	−0·1	32°	+0·1
42°	0·0	42°	+0·1
52°	0·0	52°	0·0
62°	−0·1	62°	−0·1
72°	0·0	72°	0·0
82°	−0·1	82°	−0·1
92°	−0·2	92°	−0·1

These thermometers were not employed in taking the ordinary meteorological observations.

Interruptions in the Records.

There have been only two cases of interruption during the year 1882-83. One was a break of 9 days at Bhuj owing to one observer having been ordered away on medical duty before the other,

who had been sent down to Bombay for training, was ready to take over charge. The other was break at Zanzibar, owing to the observer, Shaik Adam, having been committed to jail on the 31st January. During nearly the whole period from the 1st February up to the end of March, Dr. Bartholomeux, the Superintendent of the observatory, very kindly took barometer and thermometer readings at 10 hours and 16 hours in order to prevent a complete break in the observations at this important station.

Character of the Work of the Observers.

Table II which will be found in the Appendix [1] gives a list of the errors under different headings which have been discovered in the work of the observers at the different stations. And from these, the order of merit of the observers has been calculated, by assigning a maximum number of 200 marks to each one, and subtracting from that number the total of the mistakes each one has made in the year, or would have made during a year if his work had continued so long, and had remained of the same average character throughout. Calculating in this way the following is their order of merit :—

Name.	Number of merit.	Remarks.
Hiralal	200	Recommended for good work allowance of Rs. 5; but time of service too short.
Damoder Bhide	200	Volunteer observatory. Not now in the Department.
Corporal W. Birch	196	Not now in the Department.
Bapalal Mehta	196	Recommended for good work allowance of Rs. 5; but time of service too short.
G. W. M. D'Aranjo	192	Volunteer observatory.
Ameenullákhán	191	Not now in the Department.
Solomon Samuel	190	Obtained good work allowance of Rs. 5 this year.
Corporal H. Farmer	190	Had a good work allowance of Rs. 10 last year. Not now in the Department.
Samuel Gregory	190	Had a good work allowance of Rs. 5 last year. Obtained one of Rs. 10 this year.
Mahadev Cuddum	188 average.	Obtained good work allowance of Rs. 5 last year.
Narayen Mane	187	Obtained good work allowance of Rs. 10 last year.
Surgeant T. Murphy	187	Not now in the Department.
Private F. Bateman	186	Ditto ditto.
V. E. Nazareth	186	
Mahesh Buxsing	185	
Ram Lal	184	Obtained good work allowance of Rs. 5 last year.
Vousiff David	184	Not now in the Department.
Anajee Pandurang	183	Ditto ditto.
Dhunjibhai Motabhai	181	Obtained good work allowance of Rs. 5 last year.
Private E. Killick	180	Not now in the Department.
Pandurang Krishnaji	165	

[1] Not Printed.

Name.	Number of merit.	Remarks.
Hospital Sergeant C. Barley . . .	164	Not now in the Department.
Trimbakrao	162	
Enoch Shadrach	162	Not now in the Department.
Keshav Govind	156	Ditto ditto.
W. J. Neil	154	Ditto ditto.
Bukaram Pandurang	152	Obtained good work allowance of Rs. 5 last year.
Atmaram Bapuji	152	
T. Bachu	142	Obtained good work allowance of Rs. 5 last year.
Karim Rajakhan	60	Not now in the Department.
Gopal Cuddum	—144	His work has now much improved.

From this list it will be seen that the work is of a creditable character.

Two of the men have got the full 200 marks, and out of thirty-one men twenty have obtained over 180. The remarkably low number of Gopal Cuddum is due to the fact that, for some unexplained reason, his barometer readings from 17th December 1882 to 20th January 1883, and from 3rd to 28th February 1883, were wholly unreliable, and have had to be rejected. Karim Rajakhan has left the Department, and is not likely to be again appointed to do meteorological work. It is to be hoped that the observers will ascertain from Table II the nature of their individual defects, and endeavour in the coming year to remedy them.

Training of Observers.

There have been five second class and six third class observers trained in the Bombay Office during the year under report.

The following is the list:—

Second Class	Private E. Killick	obtained his certificate on the 5th May 1882 and was sent to Deesa.			
	Keshav Visnu Apte	do.	do.	6th March 1883	do. Belgaum.
	Ram Krisna Keshav	do.	do.	20th March 1883	do. Deesa.
	Narayan Sakaram Kelker	do.	do.	do.	do. Poona.
	Narayan Vinayek Raje	was in training on 31st March 1883, and to be sent to Kurrachee.			
Third Class	Samuel Samson	obtained his certificate on the 29th August 1882.			
	Mahesh Buxsing	do.	do.	3rd October 1882, and was sent to Bhuj.	
	Martand Ram Krishna	do.	do.	6th January 1883.	
	Shaik Abdur Rahman	do.	do.	26th March 1883, and was sent to Zanzibar.	
	Shewrattan Baijnath, Solomon Ezekiel	were in training for several days but left before obtaining their certificates.			

Besides the above Bapalal Mehta was trained at Mount Abu by Corporal C. Barley.

Appointment of Civilian Observers at Second Class Observatories.

At the suggestion of Mr. Blanford, and with the concurrence of Dr. Nolan, the Government of India have during the past year sanctioned the replacement of soldier observers at Kurrachee, Deesa, Poona, and Belgaum by civilians. This was done in order to do away with the frequent and serious breaks, which were apt to occur in the registers of these stations, owing to the soldiers being suddenly called away for military duty. At the same time, the employment of civilians is more economical, as this Department was always debited with the soldiers' military pay as well as their meteorological

allowance. The sanctioned expenditure of the four observatories during 1882-83 was, exclusive of special allowances, as follows:—

Poona	Rs.	798
Belgaum	„	700
Kurrachee	„	725
Deesa	„	831
Total	Rs.	3,054

According to the sanctioned new arrangement the cost will be as follows:—

Poona, at the rate of 1 observer, at	Rs.	30		
1 assistant, at	„	10		
Contingencies	„	2		
Total	Rs.	42	Rs.	504
Belgaum, do. do.			„	504
Kurrachee, do. do.			„	504
Deesa, do. do.			„	504
Total			„	2,016

Thus, if the cost of pensions be not taken into account, there will be an annual saving of Rs. 1,038.

In addition to the above statement of cost, a payment of Rs. 20 per mensem for two months, if necessary, was sanctioned for each civilian observer during the period of his training. The names of the four men selected, and the dates on which they received their certificates of competency, are given in the above list of observers in training. Two of them, Keshav Vishnu and Narayan Vinayek Raje, hold matriculation certificates from the Bombay University; and the other two, Ramkrishna Keshav and Narayan Sakharam Kelker, had been temporarily employed as computers in the Colaba observatory; and the latter had of his own accord while in the observatory undergone a course of training as third class observer. Narayan Vinayek Raje was not ready to receive his certificate by the 31st March 1883, but he obtained it about a fortnight later, and proceeded to Kurrachee.

The change of observers at these four stations, has not been a cause, of itself, sufficient in any case, to make it necessary to change the sites of the observatories; but as reported above, under the heading of "Inspection of Observatories" there are other causes which, when combined with this one, may make it necessary to remove their positions at Kurrachee and Belgaum. The soldier observers were always allowed free quarters for residence, but these are not guaranteed to the civilian observers. In Poona, where there are many spare rooms at the out-buildings of the Yerrowda Jail, the observer is allowed to occupy one. At Belgaum, although there are many vacant rooms in the European soldiers' married quarters, the observer is not allowed to occupy one, owing to his being a civilian; and as there are no non-military quarters within a reasonable distance of the observatory at a less rent than Rs. 10, the observer is obliged to live at a considerable distance. At Deesa the observer is allowed to occupy a room in the European soldiers' married quarters, but has to pay Rs. 3 rent for it. At Kurrachee the matter of the observer's residence is not settled. There is no doubt that it would make the observers more satisfied and tend to the effectiveness of their work if the Department would in all cases guarantee them free quarters near the observatories.

Another difficulty has arisen, namely, with regard to the carrying of messages to the telegraph and post offices, which are in every case situated at some distance from the observatories, and also with regard to cleaning and tidying the offices. It was customary for the soldier observers to engage men at their own expense to do this; and three out of the four have, since their dismissal, asked that they may be refunded the money so expended. I have tried to meet the case with regard to the civilian observers by instructing them to obtain men as assistant observers whose education and

caste shall not be so high as to prevent them from doing this work, but who at the same time shall be intelligent enough and trustworthy enough to make them capable of assisting the head observers in taking their hourly observations. But whether or not this arrangement will prove practicable cannot at present be decided.

Alterations in the Factors of Instruments.

During my inspecting tours I compared the barometers and thermometers of most of the stations with the travelling standards; the results are given below:—

Stations.	Barometer.	Dry bulb thermometer.	Dry maximum thermometer.	Wet bulb thermometer.	Wet minimum thermometer.	Dry minimum thermometer.	Grass minimum thermometer.
	Inch.	°	°	°	°	°	°
Surat	Fallen ·001	Risen 0·2	Fallen 0·1	Risen 0·2	0·0	0·0	Risen 0·3
Rajkot	Risen ·008	Fallen 0·1	„ 0·3	0·0	Risen 0·8	Fallen 0·1	Fallen 0·5
Deesa	„ ·002	„ 0·2	„ 0·7	Risen 0·2	„ 1·0	Risen 0·1	„ 0·2
Mount Abu No. 48.	„ ·083	0·0	Risen 0·1	Fallen 0·1	0·0	Fallen 0·1	0·0
Mount Abu No. 710.	„ ·005	.....	.....	.....	.....	.....	.....
Neemuch	„ ·004	Fallen 0·1	Fallen 0·1	Fallen 0·1	Risen 0·5	Risen 1·0	.....
Indore	„ ·006	„ 0·1	„ 0·9	0·0	„ 0·3	Fallen 0·1	.....
Malegaon	Fallen ·016	Risen 0·1	0·0	0·0	0·0	„ 0·1	Fallen 0·3
Kurrachee	Risen ·006	Fallen 0·2	Fallen 0·4	Fallen 0·2	Fallen 0·4	Risen 0·2	„ 0·2
Hyderabad	„ ·004	.....	0·0	.....	„ 0·1	Fallen 0·8	0·0
Jacobabad	„ ·002	Fallen 0·1	Fallen 0·1	Risen 0·2	Risen 0·8	„ 0·1	Risen 0·2
Poona	.....	„ 0·2	„ 0·2	0·0	Fallen 0·6	„ 0·1	Fallen 0·3
Ratnagiri	Risen ·004	„ 0·1	„ 0·1	Fallen 0·5	Risen 0·7	Risen 0·3	Risen 0·3
Amraoti	.....	.....	„ 0·1	.....	Fallen 0·1	„ 0·3	„ 0·4
Belgaum	Risen ·015	Fallen 0·2	0·0	Fallen 0·1	.....	Fallen 0·5	Fallen 0·7

The greatest change is shown in the new barometer at Mount Abu. It had been surmised from the comparison for storm-warning purposes of the barometric readings of this station with those of other stations that there was some considerable change in the instrument. Whether this change is due to the loss of mercury out of the cistern during transit of the instrument or to a difference of index error for the lower part of the scale, I could not ascertain. The barometer at Bickaneer also, judging from the abnormal curves prepared for guidance in the storm-warning work, appears to have been abnormally low, and will probably require to be replaced by another one.

Comparison and Issue of Instruments.

The following list[1] shows the instruments which have been issued to the observatories during the year.

Of the above the barometers, anemometers, and thermometers were all compared previous to their being issued. It is very noticeable how much more the grass radiation thermometers are subject to damage than any of the other instruments. This is owing to their being exposed to the attacks of dogs and jackals. In many cases it has been found useful to protect them by putting up around the enclosure in which the radiation thermometers are exposed a railing about 2 feet high covered with wire netting.

[1] Here omitted, being incorporated in the general list, Appendix I.

Library.

Table III of the Appendix [1] gives the list of books and pamphlets added to the library during the past year.

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Storm-Warning Service.

This service has been conducted on the same footing as last year; except that, since the 1st September 1882, the new eight-word code has been used instead of the former code which had only six words. By the use of these two extra words, it is now possible to telegraph the readings of the dry maximum and dry minimum thermometers and also the wind velocity and general weather remarks at the time of taking the observation. Another addition to the sources of information has been the daily weather telegrams received from the Meteorological Reporter to the Government of India. These telegrams have been on two or three occasions useful in confirming what had already been discovered from the reports prepared in the Bombay office.

Morning telegrams giving the observations at 10 hours have been received regularly from the following stations:—

Kurrachee.	Calicut.
Surat.	Cochin.
Ratnagiri.	Negapatam.
Karwar.	Madras.
Mangalore.	Masulipatam.

And also the morning observations of Bombay have been received as usual. Besides these special morning or afternoon observations have been called for and received as follows.[2]

Telegrams of a cautionary or re-assuring nature or instructing that the storm-signals should be hoisted were forwarded as follows:—

Names of Ports.	Dates on which telegrams were sent to hoist storm-signals.	Dates on which cautionary telegrams were sent.	Dates on which re-assuring telegrams were sent.
Kurrachee	13th and 23rd July 1882	6th and 12th August and 11th and 13th September 1882, 25th January and 28th February 1883.	8th August and 11th September 1882.
Bhavnagar	13th July 1882	11th September 1882, and 25th January 1883.	11th September 1882.
Daman	1st June and 13th July 1882	Ditto ditto	3rd June and 11th September 1882.
Bombay	1st June 1882	14th May 1882	3rd September 1882.
Ratnagiri	11th „ „	24th November 1882	27th November 1882.
Goa	11th „ „	Ditto	Ditto.
Vengurla	11th „ „	...	...
Karwar	11th „ „	24th November 1882	27th November 1882.
Kumta	11th „ „	Dkto	Ditto.

During my absence from Bombay on inspecting tours, Mr. C. Chambers, F.R.S., the Superintendent of the Government Observatory, Bombay, examined the daily weather charts and reports, and advised the office as to the calling in of special telegrams and the issue of storm-warnings.

Much inconvenience has been felt by myself and the storm-warning clerks, owing to the want of accommodation for residence. During stormy weather it is frequently necessary that night work should be done; and reference has then to be made to the Meteorological Reporter during the night, so that it is necessary that he should live near the office; and for the same reason it is very desirable that the weather clerks also should live near to the office, instead of more than 3 miles away, as is the case at present.

[1] Not printed. [2] This list omitted.

During the year, I have forwarded to Mr. Blanford a special report on the working of the storm-warning system in Bombay, in which I have stated distinctly what I consider to be the chief disadvantages under which it has to be worked; it is not therefore necessary to detail them here.

* * * * * *

Office Establishment.

Mr. Frederic Chambers, the permanent incumbent of the office, applied for one year's furlough under rule 131, but owing to delays in obtaining it was obliged to apply for leave on medical certificate under rule 127, and gave over charge of the office on the 6th June 1882 to Surgeon-Major W. Nolan, M.D., B.Sc., who on the 17th July 1882 handed over the office to me in accordance with Government of India's letter Nos. $\frac{49\,\text{Met}}{2\text{-}18}$ dated the 23rd June 1882, to the Government of Bombay.

The office establishment at the end of the year was as follows:—

Name.	Monthly pay.
For Land Meteorology.	Rs.
Ganesh Sadashiv	54
Vajeram Ichharam	39
Mahadev Ramchandra	38
Krishnaji Ramchandra	30
Ramchandra Sadashiv	30
For Storm-warning Service.	
Ramchandra Govind	30
Anant Vishvamber	30

There is also one menial whose pay is Rs. 10 per month. Mr. Mahadev Ramchandra took privilege leave for fifty days, from the 4th April 1883 to the 23rd May 1883.

The two weather clerks, in accordance with Mr. Chambers' instructions, attended the early morning classes at the Sir Jamsetji Jijibhai School of Art, and went through the preliminary and 2nd grade examinations with very creditable results in the case of Mr. Ramchandra Govind and only moderate results in the case of Mr. Anant Vishvamber.

I have always found the various members of the office staff efficient in their duty, and their thorough knowledge of the routine work of the Department has been of great assistance to me during my term of office.

Work of the Office.

The work of the office has during the year under report consisted of the usual receipt, correction, computation and tabulation of the results from the third class observatories, and the correction and tabulation of those from the second class observatories; and also of the work connected with the storm-warning system. The complete monthly returns have been forwarded as usual to the Meteorological Reporter to the Government of India, and the monthly abstracts published in the *Bombay Government Gazette*.

A sketch of the meteorology of the Bombay Presidency, in 1881, was prepared by me shortly after having taken over charge of the office. In this sketch I made a comparison between series of barometric abnormal observations of Zanzibar, Belgaum, and Bombay, and briefly discussed the possibility of the use of the Zanzibar observations for the purpose of predicting the nature of the coming seasons in Western India. This matter I followed up subsequently in a paper entitled "A contribution to the study of the Transmission Eastwards round the globe of Barometric Abnormal Variations." A copy of this paper was forwarded to the Meteorological Reporter to the Government of India. I had intended to have followed up this subject still further, but other work has prevented me.

I have also worked out a special mechanical arrangement which when coupled with the ordinary cups of the Robinson anemometer will give traces of the longitudinal and latitudinal wind components.

The storm data collected by Mr. Chambers from a number of ship logs kindly furnished by Captain Morland, the Port Officer of Bombay, have been tabulated in a form convenient for purposes of investigation, and it was my intention to have conducted the investigation. I had decided upon what I thought would be a useful method of work; but I have not been able owing to other engagements to follow up the matter.

In conclusion, I would state that many of the medical officers in charge of the observatories have taken special interest in the meteorological work, and the thanks of the Department are due to them for their trouble.

A. N. PEARSON,
Acting Meteorological Reporter for Western India

METEOROLOGICAL OFFICE, BOMBAY;
Dated the 6th June 1883.

APPENDIX F. II.

Names of the Superintendents and of the Observers at the Meteorological Observatories in Western India during the year 1882-83.

Observatory.	Class.	Superintendent.	Date. From	Date. To	Observer.	Date. From	Date. To	Remarks
Kurrachee	Second	Surgeon-Major J. Paxton	1st April 1882	31st March 1883	Private F. Bateman	1st April 1882	31st March 1883.	
Deesa	Do.	Brigade-Surgeon C. MacDowell	1st April ,,	11th Feb. ,,	Corporal W. Birch	1st April ,,	20th June 1882.	
		Surgeon-Major J. Lyons	12th Feb. 1883	31st March ,,	Private E. Killick	21st June ,,	26th March 1883.	
					Ramkrishna Keshav	27th March 1883	31st March ,,	
Yerrowda (Poona)	Do.	Surgeon J. P. Greany	1st April 1882	30th Nov. 1882	Sergeant T. Murphy	1st April 1882	31st March ,,	
		Surgeon-Major S. M. Solomon	1st Decr. ,,	31st March 1883	... ...	.....	.....	
Belgaum	Do.	Brigade-Surgeon S. A. Lithgow	1st April ,,	4th April 1882	Lance Corporal H. Farmer	1st April 1882	15th March 1883.	
		Surgeon Harmon	5th April ,,	9th April ,,	Keshav Vishnu	16th March 1883	31st March ,,	
		Surgeon-Major F. W. Hodder	10th April ,,	28th Nov. ,,	... ...	.....	.....	
		Do. R. P. Ferguson	29th Nov. ,,	31st March 1883	... ...	.....	.....	
Jacobabad	Third	Surgeon M. L. Bartholomeux	1st April ,,	11th May 1882	Karim Rajakhan	1st April 1882	21st Oct. 1882.	
		Do. J. McCloghry	12th May ,,	31st March 1883	Narayen Mane	22nd Oct. ,,	31st March 1883.	
Bickaneer	Do.	No Superintendent	.....	.....	Ram Lal	1st April ,,	31st March ,,	
Hyderabad (Sind)	Do.	Surgeon-Major C. S. Close	1st April 1882	3rd Oct. 1882	Yousiff David	1st April ,,	16th May 1882.	
		Do. H. M. Macbeth	4th Oct. ,,	31st March 1883	W. J. Neil	17th May ,,	31st Oct. ,,	
					V. E. Nazareth	1st Nov. ,,	31st March 1883.	
Bhuj	Do.	Surgeon W. A. Barren	1st April 1882	31st March ,,	Narayen Mane	1st April ,,	1st Oct. 1882	
					No Observer	2nd Oct. ,,	10th Oct. ,,	
					Mahesh Buxsing	11th Oct. ,,	31st March 1883.	
Mount Abu	Do.	Surgeon-Major C. W. Watling	1st April ,,	18th Sept. 1882	Hospital Sergeant C. Barley	1st April ,,	30th Sept. 1882.	
		Surgeon A. Hewett	19th Sept. ,,	9th Decr. ,,	Bapalal Mehta	1st Oct. ,,	31st March 1883.	
		Surgeon-Major C. White	10th Decr. ,,	31st March 1883	... ...	.....	.....	
Neemuch	Do.	Do. J. McD. O'Farrell	1st April ,,	15th Jany. ,,	T. Bachu	1st April 1882	7th April 1882.	
		Do. J. R. Croker	16th Jany. 1883	31st March ,,	S. Samson	8th April ,,	19th April ,,	
					T. Bachu	20th April ,,	31st March 1883.	

Names of the Superintendents and of the Observers at the Meteorological Observatories in Western India during the year 1882-83.—contd.

Observatory.	Class.	Superintendents.	Date. From	Date. To	Observers.	Date From	Date To	Remarks.
Indore	Third	Surgeon-Major D. F. Keegan	1st April 1882	10th May 1882	Trimbukrao	1st April 1882	31st Mar. 1883.	
		Do. R. Caldecott	11th May ,,	9th August ,,	... ...	.....	.....	
		Do. D. F. Keegan	10th August ,,	31st March 1883	... ...	.....	.....	
Rajkot	Do.	Surgeon G. H. Bull	1st April ,,	15th Oct. 1882	Solomo Samuel	1st April 1882	31st Mar. 1883.	
		Surgeon-Major H. R. L. MacDougall	16th Oct. ,,	16th Nov. ,,	... ...	.....	.....	
		Surgeon D. A. Gomes	17th Nov. ,,	28th Jany. 1883	... ...	.....	.....	
		No Superintendent	29th Jany. 1883	3rd Feb. ,,	... ...	.....	.....	
		Surgeon M. B. H. Braganza	4th Feb. ,,	22nd March ,,	... ...	.....	.....	
		No Superintendent	23rd March ,,	28th March ,,	... ...	.....	.....	
		Surgeon-Major S. B. Holiday	29th March ,,	31st March ,,	... ...	.....	.....	
Surat	Do.	Surgeon F. Jones	1st April 1882	4th May 1882	Dhunjibhai Motabhai	1st April 1882	31st Mar. 1883.	
		Do. B. N. Koyaji	5th May ,,	6th Oct. ,,				
		No Superintendent	7th Oct. ,,	16th Oct. ,,				
		Surgeon-Major J. Robb	17th Oct. ,,	31st Mar. 1883				
Akola	Do.	Surgeon J. J. Moran	1st April ,,	31st Mar. ,,	Samuel Gregory	1st April 1882	31st Mar. 1883	
Amraoti	Do.	Do. T. Hume	1st April ,,	31st Mar. ,,	Enoch Shadroch	1st April ,,	13th May 1882	
					Bukaram Pandurang	14th May 1882	9th Nov. ,,	
					Mahomed Samsudin	10th Nov. ,,	19th Nov. ,,	
					Bukaram Pandurang	20th Nov. ,,	27th Mar. 1883	
					Mahomed Samsudin	28th Mar. 1883	31st Mar. ,,	
Chikalda	Do.	Do. C. Mallins	1st April 1882	22nd June 1882	Ameenula Khan	1st April 1882	31st Oct. 1882	
		Do. D. F. Dymott	23rd June ,,	29th Dec. ,,	Hiralal	1st Nov. ,,	31st Mar. 1883	
		Do. C. L. Swaine	30th Dec. ,,	31st Mar. 1883				
Buldana	Do.	Do. D. Callaghan	1st April ,,	31st Mar. ,,	Pandurang Krishnaji	1st April ,,	31st Mar. ,,	
Malegaon	Do.	Do. W. A. Corkery	1st April ,,	30th Aug. 1882	Gopal Cuddum	1st April ,,	1st Aug. 1882	
		Do. A. S. Faulkner	31st Aug. ,,	17th Mar. 1883	Anaji Pendurang	2nd Aug. ,,	19th Nov. ,,	

		Do. P. J. Damania	18th Mar. 1883	31st Mar. ,,	Gopal Cuddum	20th Nov. ,,	12th Jan. 1883
					Atmaram Laliaji	13th Jan. 1883	22nd Jan. ,,
Sholápur	Do.	Do. H. B. Briggs	1st April 1882	22nd Mar. ,,	Gopal Cuddum	23rd Jan. ,,	31st Mar. ,,
		Apothecary W. R. Scorgie	23rd Mar. 1883	31st Mar. ,,	Keshav Govind	1st April 1882	25th Dec. 1882
Ratnagiri	Do.	Surgeon-Major M. M. Mackenzie	1st April 1882	25th May 1882	Atmaram Bapuji	26th Dec. ,,	31st Mar. 1883
		Surgeon H. McCalman	26th May ,,	31st Mar. 1883	Mahadev Cuddum	1st April ,,	26th Mar. ,,
					Somji Gharoji	27th Mar. 1883	30th Mar. ,,
Zanzibar	Do.	Surgeon-Major J. Robb	1st April 1882.	19th Aug. 1882	Mahadev Cuddum	31st Mar. ,,	31st Mar. ,,
		Surgeon M. L. Bartholomeux	20th Aug. 1882	31st Mar. 1883	Shaik Adam	1st April 1882	31st Jan. ,,
Karwar	Voluntary	R. G. C. Westbrook, Esq., Port Officer	1st April ,,	31st Mar. ,,	Surgeon M. L. Bartholomeux	1st Feb. 1883	31st Mar. ,,
					Damoder Bhidi	1st April 1882	30th April 1882
					G. W. M. D'Aranjo	1st May ,,	30th June ,,
					Damoder Bhidi	1st July ,,	30th Sep. ,,
Calicut	Storm-warning Service.	Henry Richardson, Esq., Port Officer	1st April 1882	31st Mar. 1883	G. W. M. D'Aranjo	1st Oct. ,,	31st Mar. 1883
					F. D. Rozario	1st April 1882	12th Oct. 1882
					Aroomoogum Modelliar	13th Oct. ,,	19th Oct. ,,
					F. D. Rozario	20th Oct. ,,	5th Mar. 1883
					Aroomoogum Modelliar	6th Mar. 1883	7th Mar. ,,
					F. D. Rozario	8th Mar. ,,	31st Mar. ,,

APPENDIX G.

Return showing the names of Superintendents aad Observers of the Observatories in British Burma for the year 1882-83.

Name of station.	Designation of officer.	Name and rank of officer.	Term of service.
Rangoon	Superintendent	Hugh Johnstone, Surgeon-Major	From 1st April 1882 till 31st March 1883.
	Observer	A. Sarfas	„ 1st April 1882 till 31st July 1882.
	Ditto	G. E. Wales	„ 1st August 1882 till 31st March 1883.
	Assistant Observer	Moung Loo Yin	„ 1st April 1882 till 31st December 1882.
	Ditto	Moung Meh Uyo	„ 1st January 1883 till 31st March 1883.
Bassein	Superintendent	S. H. Dantra, Surgeon, Bengal Medical Department.	Throughout the year.
	Observers	A. Soon	From 1st April 1882 to 31st January 1883.
		Chand Khan	„ 1st to 13th February 1883.
		Moung Hpay	„ 14th February to 31st March 1883.
Thyetmio	Superintendent	Surgeon P. W. Dalzell	„ 1st April 1882 to 26th July 1882.
	Ditto	Surgeon E. P. Frenchman	„ 27th July 1882 to 31st March 1883.
	Observer	2nd Class Hospital Assistant Alla Deen.	„ 1st April 1882 to 31st March 1883.
Moulmein	Superintendent	Surgeon-Major W. F. de Fabeck, M.D., Civil Surgeon.	Throughout the year.
	Observer	2nd Class Hospital Assistant F. St. Hilbert.	
Mergui	Superintendent	Asstistant Surgeon Omerto Lall Moonshi.	From 1st April 1882 to 2nd November 1882.
	Ditto	Hospital Assistant Rajib Ally	„ 3rd November 1882 to 31st March 1883.
	Observer	Mahomed Cassim	„ 1st April 1882 to 22nd March 1883.
	Ditto	Moosajee	„ 23rd March 1883 to 31st March 1883.
Tounghoo	Superintendent	Surgeon R. Pemberton	„ 1st April 1882 to 6th March 1883.
	Ditto	Ditto Maurice Smith	„ 7th March 1883 to 31st March 1883.
	Observer	3rd Class Hospital Assistant V. Chinasawmy Pillai.	„ 1st April 1882 to 6th March 1883.
	Ditto	1st Class Hospital Assistant M. Banboo, No. 874.	„ 7th March 1883 to 31st March 1883.

RANGOON;
The 29th May 1883.

D. SINCLAIR, M. B.,
Offg. Sanitary Commissioner,
British Burma.

APPENDIX H.

Return of the Stock and Issue of Instruments for the year 1882-83.

Instruments.	In Store on 1st April 1882.	Received 1882-83.	Issued 1882-83.
Van Rysselberghe's meteorograph	1	...	...
Barometers, observatory, Fortin's principle	12	3	8
Do. do. Kew principle	3	3	4
Do. mountain portable tripod (Adie)	22	5	6
Do. Marine Kew principle	26	...	4
Do. Newman's large standard	2	...	...
Do. do. small standard	4	...	...
Do. Negretti and Zambra (various)	14	4	7
Aneroids	19	...	1
Thermometers standard with attached scales	21	2	3
Do. without attached scales	1	...	...
Do. for hygrometers (Kew pattern)	93	8	22
Do. maximum for shade	132	9	16
Do. minimum do.	65	15	26
Do. do. radiation	12	53	33
Do. solar in Vacuo	47	5	16
Ponillet's pyrheliometer	1	...	...
Stewart's actinometers	1	1	2
Spare thermometers for do.	...	...	2
Hodgkinson's actinometers	2	...	...
Herschell's do.	1	...	...
Regnault's hygrometers	3	...	...
Daniell's do.	10	...	...
Halleur's do.	5	...	...
Boiling point thermometers	6	...	...
Pocket spectrescopes (Browning's)	2	...	...
Wind vanes	20	2	4
Anemometers	11	21	5
Anemographs (Beckley's)	...	3	1
Raingauges (Symon's and Glaisher's)	21	6	20
Measure glasses for do.	1	27	9
Reading lenses	5	3	5
Sun thermometer stands	24	1	4
Radiation pads	3	10	10

Return of the Stock and Issue of Instruments for the year 1882-83—(continued.)

Instruments.	In store on 1st April 1882.	Received, 1882-83.	Issued, 1882-83.
Thermometer cages	2	8	6
Do. for ships	7	12	4
Prismatic compass	1	...	...
Sand glasses (3 minutes)	29	6	30
Chain for Casella's anemograph	15 ft.	...	15 ft.
Sunshine recorder	1	...	...
Bulls' eye lantern	1	...	...
Salinometers	40	...	4
Common thermometers, brass scales	33	...	5
Clocks	3	4	5
Sling thermometers	...	10	...
Six's thermometers	...	2	2
Maximum thermometers	2	...	...
Mathematical instruments, drawing box	...	1	1
Glass disk for Nephescope	...	1	1
Pointer for do.	...	1	1
Spirit level	1	...	...
Hick's barograph	1	...	...
Thermograph with Negretti's and Zambra's sets of recording thermometers	1	...	...

APPENDIX I.

Return of the Instruments issued to each Observatory in 1882-83.

Provinces.	Stations.	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum thermometer.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer.	Wind Vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sundial.	Sand glass.	Sunshine Recorder.	Pad for glass radiation thermometer.	Cage.	Stand for sun thermometer.	Salinometer.	Common thermometer.	Standard thermometer.	Remarks.
Africa.	Zanzibar	...	...	...	...	...	...	...	...	...	...	...	...	...	1*	...	...	...	...	...	...	...	...	...	* In lieu of one out of order.
Cashmere.	Leh†	2	2	1	1	1	...	1	1	1	...	1	1	...	...	1	...	...	1	2	1	...	...	...	† Also Six's thermometers.
Punjab.	Mooltan	...	..	...	...	...	...	...	...	...	...	1	...	...	...	...	..	...	...	...	...	...	...	...	
	Dera Ismail Khan	1	...	...	...	...	...	...	1	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	
	Peshawar	...	.	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Murree	1	...	...	1	...	...	...	1	...	1	...	...	1	...	..	...	...	...	...	...	...	...	...	
	Rawalpindi	...	...	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	

Return of the Instruments issued to each Observatory in 1882-83—(continued.)

Provinces.	Stations.	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum thermometer.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer.	Wind Vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sundial.	Sand glass.	Sunshine Recorder.	Pad for glass radiation thermometer.	Cage.	Stand for sun thermometer.	Salinometer.	Common thermometer.	Standard thermometer.	Remarks.
Punjab—*contd.*	Sialkot	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Lahore	...	...	..	...	...	...	1	...	...	...	...	...	...	...	...	1	..	...	...	...	...	...	...	
	Delhi	..	...	...	...	...	...	...	1	...	..	...	...	...	1	...	...	...	...	...	...	...	...	...	
N.-W. P. and Oudh.	Pauri	...	..	.	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	
	Roorkee	1	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	
	Ranikhet	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	
	Meerut	...	...	...	...	...	1	...	1	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	
	Agra	...	...	...	...	...	...	1	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	
	Lucknow	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Gorakhpur	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Allahabad. Old observatory	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	1	1	...	...	...	...	...	
	Allahabad. New ditto	...	1	1	2	2	1	1	1	...	...	1	...	...	...	...	...	...	1	1	1	...	...	...	Original furniture.
	Benares	...	...	..	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Assam.	Sibsagar	...	..	...	...	...	...	...	..	...	...	...	...	...	...	1	...	...	...	...	...	..	...	...	
	Dhubri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	
	Tura	...	1	1	1	1	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	Original furniture.
Bengal.	Darjeeling (St. Paul's School)	2*	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	* Original furniture. † Old Instrument returned for verification.
	Durbhanga	...	...	...	...	...	..	...	...	1*	...	...	...	...	1	...	...	...	...	...	...	...	...	...	* To replace old one.
	Patna	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2*	..	...	...	...	...	...	...	* One broken in transit.
	Gya	1*	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	* For comparison.
	Hazaribagh	...	1*	1*	1*	1*	2*	...	1†	...	...	...	...	...	...	...	1	.	...	...	...	...	...	...	* Old Instrument returned for verification. † To replace old Instrument.
	Berhampore	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Dacca	...	...	...	...	1	...	...	...	1*	...	...	...	...	...	1	...	...	...	...	...	...	...	...	* To replace old one.
	Chittagong	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	
	Saugor Island	...	...	...	...	...	...	1	1*	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	* To replace old one.
	Cuttack	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	
	False Point	2*	...	.	...	...	...	...	...	1	1	..	...	...	...	...	...	...	...	...	...	...	...	...	* Old Instrument returned for verification. † For comparison.
Central Provinces.	Sambalpur	1	1	1	1	1	1	1	1	...	1	1	...	...	...	.	...	1	1	1	...	...	...	...	Original furniture of duplicate observatory.
	Raipur	2	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	

Return of the Instruments issued to each Observatory in 1882-83—(continued.)

Provinces.	Stations.	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum thermometer.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Crass.	Anemometer.	Wind Vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sundial.	Sand glass.	Sunshine Recorder.	Pad for glass radiation thermometer.	Cage.	Stand for sun thermometer.	Salinometer.	Common thermometer.	Standard thermometer.	Remarks.
Central Provinces—*contd.*	Nagpur	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Seoni	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Jubbulpore	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Pachmarhi	...	...	...	...	...	...	...	...	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	* Anemograph, Beckley's.
	Hoshangabad	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Chanda	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Berars.	Chikalda	...	...	...	...	1*	...	...	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	* In lieu of one out of order.
	Buldana	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2*	...	...	...	...	...	* Ditto.
	Akola	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2*	...	...	...	...	...	* Ditto.
	Amraoti	1‡	...	...	...	...	...	...	1†	1*	...	...	...	...	1*	...	...	...	1*	...	...	...	...	...	* Ditto. † Do. broken. ‡ Exchanged.
Central India.	Neemuch	...	...	...	...	...	...	...	2†	...	...	...	...	...	...	...	...	...	2*	...	...	...	...	...	* In lieu of one out of order. † Do. broken.
	Nowgong	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Sutna	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Indore	...	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	...	...	1*	...	...	...	...	...	* Do. out of order. † In lieu of one broken.
Rajputana.	Bickaneer	...	...	...	...	...	...	...	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	* Do. out of order.
	Sambhar	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Mount Abu	...	...	...	...	...	...	1†	2†	...	...	...	1†	...	1*	...	...	...	1*	...	...	...	...	...	* Ditto. † Do. broken.
	Ajmere	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bombay.	Jacobabad	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	In lieu of one out of order.
	Hyderabad	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Ditto.
	Kurrachee	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	Ditto.
	Bhuj	...	...	...	1†	...	...	...	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	* Ditto. † Do. broken.
	Rajkot	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	1	...	...	...	...	...	Do. out of order.
	Deesa	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Do. broken.
	Surat	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Ditto.
	Poona	...	...	...	...	...	...	1*	1*	...	...	...	1*	...	...	...	...	...	2†	...	...	...	...	...	* Ditto. † Do. out of order.
	Ratnagiri	...	...	...	...	...	...	...	...	1*	...	...	...	1†	...	...	...	...	1†	...	...	...	...	...	* Casella's Anemograph. † Do. out of order.
	Belgaum	...	...	...	...	...	...	...	...	...	...	...	1*	...	...	...	...	...	2†	...	...	...	...	...	* In lieu of one broken. † Do. out of order.

Return of the Instruments issued to each Observatory in 1882-83.—(concluded.)

Provinces.	Stations.	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum thermometer.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer.	Wind Vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sundial.	Sand glass.	Sunshine Recorder.	Pad for glass radiation thermometer.	Cage.	Stand for sun thermometer.	Salinometer.	Common thermometer.	Standard thermometer.	Remarks.
Madras, Mysore and Coorg.	Masulipatam	1	1	1	...	1	2	...	1	1	...	1	1	...	1	...	1	...	...	...	...	...	...	...	
	Secunderabad	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	
	Bellary	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Mangalore	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	..	...	...	...	
	Bangalore	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Salem	...	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Wellington	...	1	1	...	...	...	...	...	1	...	...	...	...	1	...	..	...	...	...	...	...	...	..	
	Coimbatore	...	1	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Trichinopoly	...	...	...	...	...	...	1	1	1	...	1	1	...	...	1	...	...	...	...	...	...	...	...	
	Negapatam	1	...	...	...	...	...	...	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	
	Cochin	...	...	...	...	...	...	1	1	1	...	1	1	...	...	1	...	...	...	...	...	...	...	...	
	Kurnool	1	1	1	1	1	1	1	1	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	Original furniture.
	Gopalpore	...	...	...	1	1	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	Ditto.
	Coconada	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Calicut	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Ditto.
Burma.	Akyab	...	...	...	...	1	1	1	...	...	...	1	1	...	...	...	1	...	...	...	...	...	...	...	
	Thyetmio	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Tounghoo	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Bassein	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Diamond Island	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Rangoon	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Kailang	2	2	2	2	2	2	...	1	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	Ditto.
	Alipore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	2	...	...	...	...	2	
	F. L. V. "Comet"	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1	..	
	" "Planet"	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1	...	
	" "Meteor"	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	
	S. S. "Shahzada"	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	1	...	
	S. S. "Shahjahan"	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	1	...	
	Dehra (Forest School)	...	..	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Makhla	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Jodhpur	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	..	
	Kilba	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	
	Patuakhali	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	

APPENDIX K.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	The Editor of the *Delhi Gazette.*
Ajmere	Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Le Général Commandant Superieur du Genie en Algerie.
Allahabad	Secretary to the Government, North-Western Provinces and Oudh.
	Department of Revenue and Agriculture, North-Western Provinces and Oudh.
	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
	Editor of the *Pioneer.*
	The Accountant-General, North-Western Provinces and Oudh.
Amsterdam	Royal Academy of Sciences.
Bangalore	Chief Commissioner, Mysore and Coorg.
	Conservator of Forests, Mysore and Coorg.
Batavia, Java	Meteorological Observatory.
Berlin	Ditto Institute.
Bombay	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
	Bombay University.
	Asiatic Society of Bombay.
	Bombay Sassoon Mechanic's Institute.
	Geographical Society of Bombay.
	Editor of the *Bombay Gazette.*
	Ditto *Times of India.*
	Elphinstone College.
Brisbane, Queensland	Observatory.
Brussels	Royal Academy of Sciences.
	Observatoire Royal.
Budapesth	Observatory.
Calcutta	Secretary of State for India (through Revenue and Agricultural Department).
	Secretary to the Government of India, Revenue and Agricultural Department).
	Ditto ditto Home Department.
	Ditto ditto Public Works Department.
	Ditto ditto Foreign Department.
	Ditto ditto Department of Finance and Commerce.
	Ditto ditto Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor General of India.
	Superintendent, Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanic Gardens, Calcutta.
	Inspector General of Forests, with the Government of India.
	Surgeon-General ditto ditto.
	Asiatic Society, Bengal.
	Indian Museum Library.
	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the *Calcutta Review.*
	Ditto *Statesman and Friend of India.*

List of Recipients of the Publications of the Meteorological Office—(continued.)

Calcutta	Editor of the *Englishman*.
	Ditto *Indian Daily News*.
	Ditto *Hindu Patriot*.
	Ditto *Indian Agriculturist*.
	Reverend E. Lafont, S. J.
	The Alipore Observatory.
	Mint Master.
Cambridge	University Library.
Cambridge, Massachusetts	Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Chemnitz	Royal Meteorological Institute.
Chatham	Royal Engineer's Library.
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
Colombo	Editor of the *Ceylon Times*.
	Ditto *Ceylon Observer*.
	Surveyor General of Ceylon.
Constantinople	Observatoire Imperial Météorologique.
Copenhagen	Danske Meteorologiske Institut.
	Royal Danish Academy of Sciences.
Cordoba	Meteorological Office.
Darjeeling	Conservator of Forests, Government of Bengal.
	Editor of the *Indian Forester*.
Dehra Dun	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Dublin	Royal Dublin Society.
Edinburgh	Scottish Meteorological Society.
	Astronomer Royal for Scotland, Royal Observatory.
Elichpore	Assistant Conservator of Forests, Melghat Division.
Goa	Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Guatemala	Observatorio Meteorologico del Institut Nacional de Guatemala.
Hamburgh	Nord Deutsche Seewarte.
Havana	Real Collegio de Belen.
Hong-Kong	Superintendent, Government Civil Hospital.
Indore	Agent to the Governor General for Central India in charge of the Residency.
Iowa, U. S.	Iowa Weather Service.
Jubbulpore	Civil Surgeon of Jubbulpore.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests, Bombay, Sind Division.
Lahore	Secretary to the Government of the Punjab.
	Meteorological Reporter ditto ditto.
	Sanitary Commissioner ditto ditto.
	Conservator of Forests ditto ditto.
	Editor of the *Indian Public Opinion*.
Lisbon	Observatoire de Infante D'Luiz.
	Academy of Sciences.
London	Meteorological Council.
	Royal Society.
	Royal Asiatic Society.
	Society of Arts.
	Meteorological Society.
	Institution of Civil Engineers.
	Royal School of Mines.

List of Recipients of the Publications of the Meteorological Office—(continued.)

London	Admiralty Library.
	United Service Museum.
	British Museum.
	Editor of the *Philosophical Magazine.*
	Ditto *Athenæum.*
	Ditto *Nature.*
	Ditto *Symons's Monthly Meteorological Magazine.*
	Ditto *Westminster Review.*
	Ditto *Quarterly Review.*
Madras	Secretary to the Government of Madras.
	Ditto ditto Public Works Department, Irrigation Branch.
	Meteorological Superintendent to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, Government of Madras.
	Madras University.
	Editor of the *Madras Times.*
	Ditto *Madras Athenæum.*
	Ditto *Madras Mail.*
	Superintendent, Government Central Museum.
	The Agricultural Reporter, Government of Madras, Saidapet.
	Surgeon General, British Medical Department.
	Ditto Indian Medical Department.
	Master Attendant of Madras.
Madrid	Royal Observatory.
Manchester	Literary and Philosophical Society.
Manila	Meteorological Observatory.
Mauritius	Meteorological Society.
Melbourne, Victoria	The Observatory.
	University Library.
	Public Library.
Mexico	Central Meteorological Observatory.
Milan	Royal Astronomical Observatory.
Munich	Royal Observatory.
	Royal Bavarian Academy of Sciences.
	Geographical Society.
	The Publishers of the *Deutsche Rundschau für Geographie und Statistik.*
Nagpur	Chief Commissioner, Central Provinces.
	Sanitary Commissioner ditto.
	Inspector General of Education, Central Provinces.
	Civil Surgeon, Central Jail.
	Conservator of Forests, Central Provinces.
Naini Tal	Ditto ditto North-Western Provinces and Oudh.
New Haven, Connecticut	Connecticut Academy of Arts and Sciences.
	Editors of the *American Journal of Sciences.*
New York, U. S.	Central Park Observatory.
Ootacamund	Conservator of Forests, Government of Madras.
	Editor of the *South of India Observer.*
Oxford	Radcliffe Library.
	Radcliffe Observer, Radcliffe Observatory.
Paris	Observatoire Physique Central de Montsouris.
	Editor of *La Nature.*
	Physical Observatory, Meudon.
	Bureau Central Météorologique.
Perpignan, France	Commission Météról. des Pyréness Orientales.
Perth, W. Australia	Surveyor General.
Pesaro, Italy	Royal Observatory.

List of Recipients of the Publications of the Meteorological Office—(concluded.)

Philadelphia	Franklin Institute.
Poona	Conservator of Forests, Bombay, Northern Division.
Prag, Bohemia	Observatory.
Raipur	Civil Surgeon of Raipur.
Rangoon	Chief Commissioner, British Burma. Sanitary Commissioner ditto. Conservator of Forests ditto. Editor of the *Rangoon Times*.
Rome	Meteorological Office (Ministry of Agriculture).
Rio de Janeiro	Imperial Observatory.
Shaharunpore	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Ditto Chief Commissioner of Assam. Deputy Conservator of Forests ditto.
Simla	Quarter-Master General of India, Intelligence Branch.
Singapore	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byran.
St. Petersburgh	Observatoire Physique Central.
Strasburg	Imperial University Library.
Sydney	Observatory. University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokei, Japan	Imperial Mining Office. Imperial Meteorological Observatory.
Toronto, Canda	Magnetical and Meteorological Observatory.
Turin	R. Osservatorio Astronomico di Torino.
Upsala	Meteorological Observatory.
Utrecht	Royal Dutch Meteorological Institute.
Vienna	K. K. Central Anstalt für Meteorologie und Erdmagnetismus. K. K. Geologische Reichsanstalt. Imperial Academy of Sciences. Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
Washington, U. S.	Chief Signal Officer, United States Army. Smithsonian Institution. Naval Observatory. Hydrographic Office. Professor Cleveland Abbe, Signal Office.
Wellington, New Zealand	Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Institute.

APPENDIX L.

Presentations to the Library from the 1st April 1882 to the 31st March 1883.

Place.	Donors.	Title of Work.
ADELAIDE	Meteorological Observatory	Meteorological Observations made at the Adelaide Observatory during the year 1879.
ALGIERS	Meteorological Service	Bulletin Météorologique du Gouvernment général de l'Algérie, Nos. 1227, 1472, 1802, 2280 to 2581, 2583 to 2657.
		Elements et image photographique de la Cométe *b*, 1881.
		Resumé climatologique de l'anné 1881, January to May 1882.
		Regime pluvial de l'Algérie de 1854 à 1880.
		Tableau recapitulatif des quantités de pluie tombées quotidiennement, January to May 1882.
		Quantités de pluie tombées mensuellement dans les stations de l'Algérie. Saison pluviense, 1881-82.
ALLAHABAD	Meteorological Office	Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1881-82.
		Sketch of the Meteorology of the year 1881 in the North-Western Provinces and Oudh and Eastern Rajputana.
AMSTERDAM	Royal Academy of Sciences	Jaarboek, 1880.
		Verslagen en mededeelingen aft Natuurkunde, Vol. XVI.
		Processen Verbaal, 1880-81.
BATAVIA	Magnetical and Meteorological Observatory.	Observations made at the Magnetical and Meteorological Observatory at Batavia, Vol. V, part 6, with title page.
		Rainfall in East Indián Archipelago, 3rd year, 1881.
BERLIN	Messrs. Mayer and Müller	Acta Mathematica, No. 1.
	Meteorological Institute	Preussische statistik LXIV. Ergebnisse der Meteorologischen Beobachtungen im Jahre 1881.
BOMBAY	Government of Bombay	Eighteenth Annual Report of the Sanitary Commissioner for the Government of Bombay for 1881.
		Bombay Gazetteer Vols. II to VI, X, XII, XIII, part 1 ; Vols. XII and XIV, part 2.
	Meteorological Office	Brief sketch of the Meteorology of the Bombay Presidency in 1881.
BRERA	R. Specola di Brera	Osservazioni meteorologichi, 1880 and 1881.
CALCUTTA	Dr. D. Brandis	On the distribution of Forests in India.
	Geological Survey of India	Memoirs, Vol. IV, parts 2 and 3 ; Vol. V, parts 1, 2, 3 ; Vol. VI, parts 1 and 2 ; Vol. VII, parts 1, 2, 3 ; Vol. VIII, parts 1 and 2 ; Vol. IX, parts 1 and 2 ; Vol. X, part 2 ; Vol. XI, part 1 ; Vol. XVII, part 1 ; Vol. XIX, part 3.
		Records, Vols. I to XV and Vol. XVI, part 1.
	Government of Bengal	Report on the External Trade of Bengal with Nepal, Sikkim and Bhutan, for the year 1881-82.
		Report on the Administration of Bengal for 1881-82.
	Comptroller General	Civil Account Code, Vol. I, 2nd edition.
		Civil Estimates for 1882-83.
	G. A. Depenning	Lecture on "Gravity."
	Government of India, Home Department.	A Manual of the land revenue systems and land tenures of British India.
		Suggestions regarding the demarcation and management of the Forests in Kulu by W Schlich, Ph.D.
		Report of the Meteorological Council to the Royal Society for the year ending 31st of March 1882.
	Government of India, Revenue and Agricultural Department.	Report of the Famine Commission, Appendix V. Irrigation as a protection against famine.

Presentations to the Library from the 1st April 1882 to the 31st March 1883—(continued.)

Place.	Donors.	Title of Work.
Calcutta—*contd.*	Government of India, Revenue and Agricultural Department—*contd.*	Report of the Famine Commission, Appendix II. Proceedings of the Commission and selected evidence.
		Report on the Census of Berar, 1881.
		Report on the Census of British Burma taken on the 17th February 1881.
		Census of the Native States of Rajputana, 1881.
		Census of the province of Ajmere and Merwara taken on the 17th February 1881.
		Report on the condition and proceedings of the Government Observatory, Colaba, for the year which ended with the 30th June 1882.
		Report of the Census of the North-Western Provinces and Oudh, 1881.
		Supplement to the Census of the North-Western Provinces and Oudh, 1881.
		The Travelling Allowance Code, 1883.
	John Eliot, Esq., M.A.	The rainfall of Cheerapunji.
	Sanitary Commissioner for Bengal.	Fourteenth Annual Report of the Sanitary Commissioner for Bengal, 1881.
	Sanitary Commissioner with the Government of India.	Eighteenth Annual Report of the Sanitary Commissioner with the Government of India, 1881.
	St. Xavier's College Observatory.	Meteorological Observations recorded at the St. Xavier's College Observatory from January to December 1882.
	Surveyor General of India	General Report on the Operations of the Survey of India during 1880-81.
California	Dr. J. H. C. Bonte	The northerly winds of California.
Cambridge	Harvard College Observatory	Statement of the work done at the Harvard College Observatory during the years 1877 to 1882.
Cape of Good Hope.	Meteorological Commission	Report of the Meteorological Commission for the year 1881.
Copenhagen.	Institut Météorologique Danois	Bulletin Météorologique du Nord, February to December 1882, and January 1883.
		Annuaire météorologique pour l'année 1880, Part II.
	Kongl. Danske Videnskabernes Selskabs.	Oversigt Nos. 1, 3 of 1881; No. 2 of 1882.
Cordoba	National Observatory	Annales de la Oficina meteorologica Argentina, Tomo II.
Dehra Dun	Great Trigonometrical Survey of India.	Account of the Operations of the Great Trigonometrical Survey of India, Vols. VII and VIII.
Edinburgh	C. Piazzi Smyth	Madeira Meteorologie.
		Madeira Spectroscopic.
	Royal Society of Scotland	*Piazzi-Smyth.*—Gaseous spectra in vacuum tubes.
		Constitution of the lines forming the low temperature spectrum of Oxygen.
	Scottish Meteorological Society	Journal of the Scottish Meteorological Society, New Series, Nos. LXIV to LXIX.
Goa	Meteorological Observatory	Observacoes meteorologicas de Goa 10 Semestre di Anno de 1881.
Greenwich	Royal Observatory	Greenwich Magnetical and Meteorological Observations for 1880.
Guatemala	Institute Nacional de Guatemala	Meteorological Observations, May to August 1881.
Hamburgh	Deutsche Seewarte	Wetterbericht, Vol. VI, Nos. 119 to 132; Vol. VII, Nos. 32 to 365; Vol. VIII, Nos. 1 to 31.
		Monatliche Uebersicht der Witterung, April 1879, August 1880, October to December and year 1881, January to August 1882.
	Max Möller	Beziehungen zwischen dem ober-und Unterwinde einer Depression, &c., by Max Möller (Pamphlet).
		Beiträge zur Kenntnifs der atmosphärischen Wirbel und ihrer Beziehung zur Cirruswolke. The same (Pamphlet).
Hong-Kong	Government of Hong-Kong	Meteorological Observations taken at Hong-Kong April to June 1881; February to November 1882; January 1883.

Presentations to the Library from the 1st April 1882 to the 31st March 1883—(continued.)

Place.	Donors.	Title of Work.
Iowa	Iowa Weather Service	Notes on cloud forms and the climate of Iowa.
		Iowa Weather Service Annual Report, 1883.
		Second Biennial Report of the central station of the Iowa Weather Service.
Karlsruhe	Baden Meteorological Observatory	X, XI, XII, XIII, Jahresbericht der Grossherz, Badischen meteorologischen central Station Karlsruhe für die Jahre, 1878 *bis* 1881.
Lahore	Government of the Punjab	Report on the revised land revenue ettlement of the Rohtak District, 1873-1879.
	Meteorological Office	Meteorological Report for 1881.
London	G. J. Symons, Esq.	Symons's Monthly Meteorological Magazine; April and November 1881, March to December 1882, January and February 1883.
	Kew Committee of the Royal Society	Report of the Kew Committee for the year ending 31st October 1882.
	Meteorological Office	Weekly Weather Report. Title page of Vols. IV and V; Vol. V, Nos. 8 to 52; Vol. VI, Nos. 1—8.
		Daily Weather Reports, January to December 1881.
		Hourly readings from the self-recording instruments at the seven observatories, October to December 1880.
		Bulletin International. Bureau Central Météorologique de France, 1881.
		Report of the Meteorological Council to the Royal Society for the year ending 31st March 1881.
		Results of observations made at the Pagoda Royal Gardens, Kew, and elsewhere, to determine the influence of height on thermometric readings on vapour tension and on humidity.
		Meteorological charts for the ocean districts adjacent to the Cape of Good Hope.
		Remarks explanatory of the meteorological charts of the ocean districts adjacent to the Cape of Good Hope.
		Report of the storm of 13th to 14th October 1881.
		Meteorological Observations at six stations of the second order for the year 1879.
		Contributions to our knowledge of the meteorology of the Arctic regions, part 3.
		Report on the gales experienced in the ocean districts adjacent to the Cape of Good Hope, between Lat. 30° and 50° S., and Long. 10° and 40° E.
	Meteorological Society	Quarterly Journal. New Series, Vol. VIII, Nos. 41 to 44.
		List of fellows of the Meteorological Society on 1st March 1882.
		The Meteorological Record, Nos. IV to VII.
	The Publishers	The Colonies and India, Nos. 502 and 523.
	Royal Asiatic Society	Journal, Vol. XIV, parts i, ii and iv.
	Royal Society	Proceedings, Nos. 216 to 221.
	Society of Arts	Journal Nos. 1529 to 1575, 1577 to 1581.
Madras	Government of Madras	The Ganjam District Manual.
		Manuals of the Chingleput (late Madras), Nilgiri, Godavery, Tinnevelly, Nellore, North Arcot, and Trichinopoly districts.
		Suggestions regarding Forest administration in the Madras Presidency.
	Meteorological Office	Administration Report of the Meteorological Reporter to the Government of Madras for 1881-82.
Manilla	Observatorio del ateneo Municipal de Manila.	Ligeros Apuntes sobre el huracan del 20 de Octubre de 1882.
Mauritius	Meteorological Society	Mauritius Meteorological results for 1879 and 1880.
Melbourne	Meteorological Observatory	Monthly Record of results of observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne Observatory from June to December 1881 and January to April 1882.

Presentations to the Library from the 1st April 1882 to the 31st March 1883—(continued.)

Place.	Donors.	Title of Work.
Mexico	Central Meteorological Observatory.	Boletin, Tomo VI, Nos. 133 to 179, and 185 to 198; Tomo VII, Nos. 1 to 124; Tomo VIII, Nos. 1—7.
		Revista mensual climatologica, Tomo I, Nos. 10, 11, 13, 14.
		Anales del ministerio de Fomento, Tomo VI.
		Revista Cientifica Mexicana, Tomo I, Nos. 18 to 23.
Milan	Reale Osservatorio di Brera	Osservazioni meteorologiche orarie ottenute da strumente registratori durante l'anno, 1880.
		Operazioni esequite nell'anno, 1879, per determinare la differenza di longitudine fra gli osservatorio astronomici del compidoglio in Roma e di Brera in Milano.
Munich	K. Sternwarte	Meteorologische und Magnetische Beobachtungen, Jahrgang 1882.
	The Publishers	Deutsche Rundschau für Geographie und Statistik, Vol. IV, Nos. 7—10 and 12, and Vol. V, Nos. 1 to 6.
Manchester	Professor Balfour Stewart, LL.D., F.R.S.	An Analysis of the recorded diurnal ranges of the magnetic declination, with the view of ascertaining if these are composed of inequalities which exhibit a true periodicity.
		Preliminary report to the Solar Physics Committee on a comparison for 2 years between the diurnal ranges of magnetic declination as recorded at the Kew Observatory, and the diurnal ranges of atmospheric temperature as recorded at the observatories of Stonyhurst, Kew and Falmouth.
Nagpur	Chief Commissioner, Central Provinces.	Report on the trade and resources of the Central Provinces for the year 1881-82.
New Haven	Connecticut Academy of Arts and Sciences.	Transactions of the Connecticut Academy of Arts and Sciences, Vol. IV, part 2; Vol. V, part 2.
	Professor Elias Loomis	Contributions to Meteorology, 17th and 18th paper.
		Mean annual rainfall for different countries of the globe.
New York	Meteorological Observatory	Abstract of registers from self-recording instruments, December, and annual tables for 1881, and January to November 1882.
Oxford	Radcliffe Observatory	Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the year 1880.
Paris	Bureau Central Météorologique de France.	Bulletin international, Vol. XXV, Nos. 238, 268 to 272; Vol. XXVI, Nos. 48 to 173, 175 to 331, 335 to 365; Vol. XXVII, Nos. 1 to 60.
		Supplement, Nos. 31, 59, 90, 143, 120, 181, 243, 274, 334.
		Rapport du Comité météorologique international, Réunion de Berne, 1880.
	Mons. F. F. Hibert	Théses presentées à la faculté des Sciences de Paris.
	Mons H. Brocard	Memoires de météorologie dynamique.
	Societe Météorologique de France	Annuaire de la Société météorologique de France, 29e Année, 1881; 3rd and 4th Trimestre; 30e Année, 1882; March and April.
Perth, Western Australia.	Meteorological Branch, Survey Office.	Western Australia Meteorological Report for 1878 and 1881.
Philadelphia	Franklin Institute	Journal, Vol. CXII, No. 672; Vol. CXIII, Nos. 674 to 678; Vol. CXIV, Nos. 679 to 685.
Prague	K. K. Sternwarte	Astronomische magnetische und meteorologische Beobachtungen Jahre, 1881.
	Professor Dr. Franz Augustin	Uber den täglichen Gang des Regenfalles.
		Uber den täglichen Gang des Luftdruckes und der Lufttemperature in Prag
Rio de Janeiro	Imperial Observatory	Bulletin astronomique et météorologique, October to December 1881, and January to December 1882.
Simla	Inspector-General of Forests with the Government of India.	Suggestions regarding Forest Administration in the N.-W. Provinces and Oudh.
		Review of the Forest Administration in the several provinces under the Government of India for the year 1880-81.
Singapore	Colonial Surgeon, Straits Settlements.	Meteorological Returns for 1880 and 1881.
		Rainfall Returns for 1880 and 1881.

Presentations to the Library from the 1st April 1882 to the 31st March 1883—(continued.)

Place.	Donors.	Title of Work.
St. Petersburgh	International Polar Commission	Communications from the International Polar Commission, parts 2, 3.
	Physical Central Observatory	Repertorium für Météorologie, Band VII, Heft 2.
		Annalen des physicalischen Central observatoriums Jahrs 1880, 1881. Transit of Mercury.
Sydney	Meteorological Office, New South Wales.	Results of rain and river observations made in New South Wales during 1881.
	Observatory	Results of double star measures made at the Sydney Observatory, 1871—81.
		Abstract of meteorological observations, New Zealand, for the quarter ending 30th June 1882.
Syracuse	Osservatorio Centrale di Siracusa	Osservazioni meteorologichi, Anno VI, Nos. 1—6, 8 to 12.
Tasmania	Royal Society of Tasmania	Reports of the Royal Society of Tasmania for 1879, 1880, 1881.
Tiflis	Physical Observatory	Magnetische Beobachtungen des Tifliser physicalischen observatoriums in den Jahren 1880 and 1881.
Tokio	Imperial Meteorological Observatory.	Meteorological observations recorded at Tokio from November 1881 to May 1882; at Kioto, Nügata, Hiroshima, and Nagasaki from October 1881 to June 1882; at Nobiru from July 1881 to April 1882; at Wakayama from June 1881 to April 1882; at Aomori from January to June 1882; at Kanazama for January, February, May, and June 1882; and at Kochi from March to June 1882.
	Tokio University	Report on the Meteorology of Tokio for 1880.
Toronto	Meteorological Office	Monthly weather review, January to December 1879; May and August 1880; February to December 1882; January 1883.
		General Meteorological Register for 1882.
		Report on the Meteorological Service of the dominion of Canada for the year ending 31st December 1880.
Turin	Royal Observatory	Effemeridi del sole, della luna e dei principali pianate per l'anno, 1883.
		Sulla rifrazione—Interpretazione matematica dell ipotesi.
		Bolletino dell' osservatorio della regia Universita di Torino, Anno XVI (1881).
Upsala	Meteorological Observatory.	Bulletin météorologique mensuel, Vol. XVII, Année 1881; Vols. I to VIII, Année 1869 to 1876.
		Observations météorologiques horaires du 30 Mars 1865 au 9 Août 1868.
Vienna	Dr. J. Hann	Zeitschrift der Oesterr. Meteor. Geselschaft, XVII Band, 1882, March to December; XVIII Band, 1883, January to March.
	K. K. Central-Austalt für Meteorologie und Erdmagnetismus.	Jahrbuch Neue Folge, XV, Band, Jahrg, 1878; XIII Band, Jahrg, 1881.
		Magnetische Beobachtungen, 1879 and 1880.
		Stundliche Aufzeichnungen der autographischen Apparate für Luftdruck, Temperatur, Geschwindigkeit und Richtung des Winds am Observatorium der K. K. Centralanstalt für Meteorologie und Erdmagnetismus auf der hohen Warte bei Wien. Jahrgs, 1878 to 1881.
		Jahrbuch, Jahrgang 1878.
		Ditto ditto 1880, Erster Theil.
	K. K. Geologische Reichsanstalt	Verhandlungen, 1881, Nos. 8 to 18, with title page; 1882, Nos. 1 to 11.
	K. K. Meteorologisches, Central Observatorium.	Internationaler telegraphischer Wetterbericht, Jahrg, VI, Nos. 36—365; Jahrg VII, Nos. 1 to 59.
	Royal Academy of Sciences	*Bresina.*—Bericht über neue oder wenig bekannte Meteoroten IV.
		Exner.—Über das Funkeln der Sterne und die Scintillation überhaupt.
		Gruss.—Bahnbestimmung des Kometen V, 1877.
		Hann.—Über die monatlichen und jährlichen Temperatur Schwankungen in Österreich-Ungarn.
		Hann.—Über den Fohn in Bludeuz.
		Koch.—Bericht über den am 3. Februar l. J. Sattgefundenen Meteorsteinfall von Mocs in Siebenbürgen.

Presentations to the Library from the 1st April 1882 to the 31st March 1883—(concluded.)

Place.	Donors.	Title of Work.
VIENNA—*contd.*	Royal Academy of Sciences—(*contd.*)	*Lippich.*—Über polaristrobometrische Methoden.
		Lisnar.—Resultate magnetischer Messungen in Mähren und Schlesien.
		Hann.—Über die Temperatur der südlichen Hemisphäre.
		Tinter.—Über den Fehler beim Einstellen des Fadenkreuzes in die Bildebene.
		Bresina.—Über die Reichenbach'schen Lamellen in Météoreisen.
		Bresina—Über die Orientirung der Schnittflächen an Eisenmeteoriten mittelst der Widmannstädten'schen figuren.
		Wüllerstorf-urbair.—Die meteorologischen Beobachtungen am Bord des Polarschiffes, "Tegetthoff," Weyprecht, 1872—74.
		Anzeiger der Kaiserlichen Akademie der Wissenschaften Jahrg, 1881, Nos. XX to XXVIII, with index; Jahrg, 1882, Nos. I to XVII.
WASHINGTON	Chief Signal Office	Bulletin of International Meteorological Observations, 25th July to 31st December 1880; 1st February to 31st August 1881.
		Monthly weather review, 1881, October to December; 1882, January to November.
		Daily charts, 1st to 31st December 1880.
		Report of the Chief Signal Officer, War Department, 1879.
		Annual Report of the Chief Signal Officer of the Army, to the Secretary of War for 1822.
		Professional papers of the Signal Service No. 1. Total Eclipse of the Sun July 1878, Abbe. No. 2. Isothermal lines of the United States, 1871—80. No. 3. Chronological list of Auroras observed from 1870 to 1879. No. 4. Tornadoes of May 29th and 30th, 1879. No. 5. Information relative to the construction and maintenence of Time-balls. No. 6. The reduction of air pressure to sea-level, at elevated stations west of the Mississipi river.
	Naval Observatory	Instructions for observing the transit of Venus, December 6th, 1882.
	Smithsonian Institution	Annual Report of the Board of Regents of the Smithsonian Institution for 1880.
		List of foreign correspondents of the Smithsonian Institution corrected to January 1882.
	United States Coast and Geodetic Survey.	Methods and results, meteorological researches, part 3, barometric hypsometry and reduction of the barometer to sea-level.
WELLINGTON, NEW ZEALAND.	Meteorological Office	Abstract of meteorological observations, New Zealand, for the quarters ending 31st December 1881 and 31st March 1882.
ZI-KA-WIE	Magnetical and Meteorological Observatory.	Bulletin Mensuel, September 1881, and January to September 1882.
		Eclipse totale du soleil du 17th Mar 1882.
		The typhoons of the Chinese seas in the year 1881.
ZURICH	Swiss Meteorological Institute	Meteorologische Beobachtungen, January to December 1882.
		Meteorologische Beobachtungen, 1879.

Purchases for the Library.

Ager's Standard Telegram Code of 100,000 words.
American Journal of Science, January 1877; February to December 1882; January and February 1883.
Annalen der Physik und Chemie, Nos. 3 to 13 of 1882; Nos. 1 to 3 of 1883.
Comptes Rendus, Tome XCIV, Nos. 9 to 26; XCV, Nos. 1 to 26; XCVI, Nos. 1 to 9.
Tables des Comptes Rendus, &c., 1881, XCIII; 1882, XCIV.
La Nature, Nos. 458 to 466, 468, 470 to 493, 495 to 502, 504 to 510.
Nature, Nos. 645 to 661, 663 to 680, 682 to 685, 688 to 697; Title page and index for Vol. XXV.
Philosophical Magazine, Nos. 80 to 90 of 1882; 91 & 92 of 1883.
Report of the British Association for 1881.
Royal Society Catalogue of Scientific Papers, Vols. VII and VIII.
Workshops Receipts by Ernest Spon.

APPENDIX M.*

List of Officers in Charge and Assistants in the Madras Presidency, Meteorological Department, in the official year 1882-83.

STATION.	Officer in Charge.	From	To	Assistant.	From	To
Madras	Miss E. Isis Pogson, F.M.S., Meteorological Reporter and Assistant Government Astronomer	1st April 1882	31st March 1883	T. Vythinath Iyer, First	1st April 1882	31st March 1883.
				N. E. Kangayam Pillay, Second	1st April ,,	31st March ,,
Amini Divi	Syed Abdool Rahaman	1st April ,,	31st March ,,	.....	.....	.....
Bangalore	Surgeon P. H. Benson, M.B.	1st April ,,	31st March ,,	Rungasawmy Moodilair	1st April ,,	31st March ,,
Bellary	Surgeon-Major H. M. G. Archdall	1st April ,,	8th April 1882	B. G. Sashachellum, First	1st April ,,	31st March ,,
	Surgeon A. P. Adams	9th April ,,	30th May ,,	Sreenevasa Row, Second	1st April ,,	31st March ,,
	Surgeon-Major H. M. G. Archdall	31st May ,,	31st March 1883	.....	.....	.....
Cochin	Surgeon A. T. O'Hara	1st April ,,	23rd May 1882	.....	.....	.....
	Brigade-Surgeon W. H. Morgan	24th May ,,	31st March 1883	G. Narayanasawmy	1st April ,,	31st March ,,
Coimbatore	Surgeon G. M. E. McKee	1st April ,,	1st May 1882	.....	.....	.....
	Surgeon-Major T. F. Fitzpatrick, M.D.	2nd May ,,	31st March 1883	Varadiah Naidu	1st April ,,	31st March ,,
Kurnool	Telegraph Master, A. Wale	9th February 1883	31st March ,,	.....	.....	.....
Madura	Surgeon T. Lancaster, M.B.	1st April 1882	29th August 1882	.....	.....	.....
	Surgeon T. Leonard	30th August ,,	15th October ,,	V. Sashachellum	1st April ,,	31st March ,,
	Surgeon-Major H. J. Hastings, M.D.	16th October ,,	31st March 1883	.....	.....	.....
Mangalore	Telegraph Master F. D'Souza	1st April ,,	31st March ,,	.....	.....	.....
Masulipatam	Surgeon F. T. Doyle	1st April ,,	8th April 1882	.....	.....	.....
	Surgeon H. St. Clair Carruthers	9th April ,,	31st March 1883	Uma Ranganayahala Naidu	1st April ,,	31st March ,,
Mercara	Telegraph Master H. Duchworth	1st April ,,	31st March ,,	.....	.....	.....
Negapatam	E. N. Monis, Esq., L.R.C.P., F.R.C.S.E.	1st April ,,	31st March ,,	S. Saminatha Iyer	1st April ,,	31st March ,,
Salem	Surgeon-Major H. T. Hazlett	1st April ,,	20th April 1882	....	.....	.....
	Surgeon F. T. Doyle	21st April ,,	25th May ,,	L. Ramsing	1st April ,,	31st March ,,
	Surgeon-Major H. T. Hazlett	26th May ,,	31st March 1883	.....	.....	...

Secunderabad	Surgeon E. M. Damla	1st April 1882	1st July 1882	.....	....
	Surgeon-Major E. Fawatt, F.R.C.S.	2nd July ,,	31st March 1883	J. T. Williams	1st April 1882 31st March 188-
Trichinopoly	Surgeon-Major J. B. Thomas, L.R.C.P.L.	1st April ,,	31st March ,,	T. Lutchman, First	1st April ,, 31st March ,
				E. M. Bhojarajooloo, Second	1st April , 31st March .,
Wellington	Surgeon-Major T. Fleming, M.D.	1st April ,,	23rd October 1882	Sergeant H. Brownsell	1st April 31st March .
	Surgeon K. D. L. Kirkwood	24th October ,,	2nd November ,,		
	Surgeon-Major A. Long, M.D.	3rd November ,,	31st March 1883.		

* This was received after the Report and Appendices was in type.

Government of India Central Printing Office.—No 63 Meteor.—3-10-83.—400.

REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1883-84.

IN accordance with the practice of previous years, I preface the formal portion of my report on the working of the Meteorological Department in the year ending 31st March 1884, with a brief notice of some of the more important incidents of the year, and of the subjects to which attention has been more particularly directed.

ACTINOMETRIC OBSERVATIONS.—In the report for 1882-83, I recounted the steps taken, up to date, for training the actinometric observers to be sent to Leh, and to verify, by an ample comparison with arbitrary standards, the instruments they were to take with them. As the supply of the latter, originally sent out, proved to be in part of inferior quality, and had been seriously reduced by breakage, it was necessary to detain the observers in India until the arrival of a further supply of thermometers and the completion of their subsequent verification. The instruments arrived in May 1883, but the season of clear skies was now at an end; and although every available opportunity was utilized for carrying on the work during the rains, it was not until the end of September that it was brought to a close,—the instruments packed for safe transport across the passes, and every thing made ready for the start. Sergeant Rowland and Mr. Shaw left Dehra on the 2nd October, and reached Leh, *viâ* Murree and Srinagar, after a month's journey, arriving there on the 2nd November. All the instruments arrived in excellent order.

Their work at Dehra had been carried on under the direction and personal superintendence of Mr. Hennessey, who devised several improvements in the instruments, and organised the scheme of their work. The results of this experience he has embodied in a pamphlet of elaborate instructions, specially drawn up for the guidance of the observers,—itself an important contribution to science, and which will probably serve as the basis and guide for all future systematic work in actinometric observation. I cannot

omit to repeat the expression of my great indebtedness to Mr. Hennessey, for his valuable co-operation in organising the scheme and directing the preparations for the important work now in progress.

I have received the results of the observers' work, for the months that have elapsed since their arrival at Leh up to the end of May. Hitherto the season has proved most unfavourable. The winter and spring months have been unusually stormy in the North-Western Himalaya, the skies have been greatly obscured by cloud, and opportunities for good observation have been very rare. This is to be regretted; but it was to be anticipated that the winter observations would prove more interrupted than those of the summer, and it is to those of the summer season, when the declination of the sun is higher, the thickness of the absorbing atmosphere consequently less, and the serenity of the skies greater, that we must look for the most important results of the work.

HIMALAYAN SNOWFALL REPORTS.—In last year's report, I set forth the reasons which have led me to attach great importance to the acquisition of detailed and regular information on the state of the Himalayan snows and of the weather prevailing over the higher ranges of the mountains. And in accordance with the recommendations of the report, those passages which bore on this subject were extracted and widely circulated to officers stationed in the hill states, and whose duties bring them into communication with travellers and traders in the interior of the mountains, with the request that they would endeavour to obtain and communicate speedily to this office, from month to month, the fullest information procurable on the extent and thickness of the snows. As the result of these measures, the statistical accounts received of the snowfall of the past winter and spring have put me in possession of a body of most valuable information, —the more valuable that, throughout the higher ranges to the north-west of the Sutlej, the snowfall of the past winter and spring has been unusually heavy, while that of the outer ranges, from Kangra eastwards, has been as conspicuously deficient, and that of the inner ranges of the Central Himalaya has been much below the average. The distribution of the snows being thus known, we are enabled to trace out, with more precision than hitherto, the influence of the snow fields on the dry winds of the plains, and in this respect the experience of the present year will prove more than ordinarily instructive.

CONNECTION OF THE SNOWS WITH DRY LAND WINDS.—The views put forward in last year's report of the influence of the snows as favouring the prevalence of dry westerly winds in Northern India have been so far uniformly confirmed by the further experience of the past year.

In the spring of 1883, there was a heavy and late precipitation on the first or outer snowy range of Hazara, Murree, Kangra, Kulu, and Bussahir; and, relying on the experience previously gained, I ventured to put forward a warning in the *Gazette of India* of the 2nd June, to the effect that the monsoon rainfall of the North-Western India would probably be retarded, and that there would be a long spell of dry winds on the plains. The result was that an interrupted, sporadic, but locally heavy rainfall in the first half of July was followed by a long break, which began in the Punjab, speedily extended to the North-Western Provinces, Rajputana, Khandesh, Berar, and even the Konkan and Deccan, and lasted up to nearly or quite the end of August.

A further confirmation of the above view was afforded by the meteorology of the winter months. As a general rule, little or no snow falls on the Himalaya before Christ-

mas or the beginning of the new year, and it is then accompanied by a more or less copious rainfall on the plains of North-Western India. Last season, however, there was a fall of snow in Kashmir as early as September, and very generally on the North-Western Himâlaya in October; and early in November a very heavy fall took place everywhere to the north-west of the Sutlej. The cold season which followed on the plains and the outer Himalaya was remarkably fine,—dry cool north-west winds prevailed, with unbroken steadiness; and in Northern India, over the greater part of the Gangetic plain, and in a large area of Western India, the four months, November to February, were absolutely rainless.

Judging from present appearances, the experience of the approaching monsoon will furnish further valuable evidence as to the influence of the snows; the spring fall in Kashmir and Lahoul having been unusually heavy and also prolonged.

A paper on the connection of the Himalayan snowfall with dry winds and seasons of drought in India was lately communicated to the Royal Society of London and read at the meeting of the 1st May. In this paper, which I understand will shortly be published in the Proceedings of the Society, I have given a *resumé* of the evidence from which the above connection has been inferred. Each successive year will add to this evidence, and develop the precise character of the connection, and I anticipate, with confidence, that before many years shall have elapsed, it will be possible to forecast the prospects of any given season, at all events for North-Western India, with more precision than has hitherto been possible for this or any other country in the world.

HIMALAYAN OBSERVATORIES.—Hitherto, with the exception of Leh on the Upper Indus Valley, the only observatories for the registration of Himalayan meteorology have been those at the hill stations,—Murree, Simla, Chakrata, Mussooree, Pauri, Ranikhet, Pithoragarh, Katmandu, and Darjeeling,—all of which are on or among the outer hills, at some distance from the permanent snows. It has long been an object to obtain additional meteorological registers from the interior of the mountain tract, but there has been some difficulty in effecting this, owing to the paucity of residents, of sufficient education and intelligence to undertake the charge of the work. During the past year, through the kindly volunteered assistance of the Rev. A. Heyde, an observatory has been established at Kailang, in Lahoul, at an elevation of 10,000 feet above the sea, and to the north of the second snowy range. Mr. Heyde has been at much pains to establish the instruments in accordance with the official instructions and to obtain a properly trained observer, and in addition to the registers, which were commenced in July 1883, his personal observations on various meteorological phenomena are particularly valuable, and such as can only be furnished by an educated and observant person.

Another observatory, less remote but still within the influence of the snowy range, has lately been fitted up at Chamba, with the kind assistance of Major C. H. Marshall, the Superintendent of the Chamba State, and Dr. Hutchinson, the Resident Medical Missionary. I expect shortly to receive registers from this observatory.

INSULAR OBSERVATORIES.—With a view to ascertaining, as far as possible, the current meteorological conditions of the oceanic region, which is the source of the Indian summer monsoon, observatories have been established at Zanzibar, the Lakhadives, and the Seychelles. That at Zanzibar has now contributed registers since January 1880, first as a voluntary observatory; and in 1881, being brought on the list of paid observatories, it was raised to the status of one of the second class. The work has continued good,

and it would be a serious loss were it now to cease. Last year there appeared to be some danger of this, owing to the transfer of the political establishment of the station to Her Majesty's Foreign Office[1] and the consequent withdrawal of the medical officer, who has superintended the observatory. The Surgeon-General of Bombay has allowed the observer to remain at his post for a time, pending the reply of Her Majesty's Government to the application that the observatory may be taken over by the Foreign Office and continued. As yet no reply has been received to this application.[2]

The observatory at Amini Divi was established in September 1880, although no report of the fact was received until long afterwards, and no mention is made of it in the Administration Report for that year. The observer, a subordinate medical officer, was trained in Madras, but it would appear that either the man was naturally inefficient, or his training imperfect. In any case, his registers are of little value. Those from January 1881 to April 1882 have been entirely rejected, and those for the subsequent months of 1882 are very imperfect, while they have ceased altogether since that date. This observer has been recalled, and he has been succeeded by another man, from whom, as yet no registers have been received in my office. This observatory has been under the Meteorological Reporter to the Government of Madras.

The Seychelles observatory was equipped in 1882, but the first registers contributed were those for June 1883, since which they have been received regularly up to January 1884. They appear to be fairly good as far as they go, but many important observations are deficient. As the Meteorological Officer of the Mauritius Government has also an observer here, it is desirable, if possible, that the two Departments should co-operate, and I have had some correspondence with Mr. Meldrum, the Meteorological Officer of the Mauritius, on this subject. There is much difficulty in controlling these remote observatories, as there is, as a rule, no one on the spot, having any technical knowledge of meteorology, and the observers are necessarily left to the guidance of their own intelligence with such assistance as they can obtain from the printed instructions.

FIRST CLASS OBSERVATORIES IN INDIA.—It was proposed as a part of the scheme of re-organisation sanctioned by Government in 1875, that in addition to the then existing first class observatory at Bombay, observatories furnished with autographic instruments should be established at Calcutta, Allahabad, and Lahore. The first of these was provided under the Lieutenant-Governorship of Sir G. Campbell, who erected a suitable building for the purpose at Alipore, and this has now been working steadily and with satisfactory results since the spring of 1877. Owing to the want of buildings in any suitable site, the provision of similar observatories at Allahabad and Lahore has hitherto remained in abeyance, and, in fact, as regards suitability of site, the existing observatories at both these seats of Government are far inferior to those at the large majority of the minor stations.

It is therefore with much satisfaction that I am able to report that at Lahore there is, at length, a prospect of a suitable building being shortly placed at the disposal of the Department. Shortly after the close of the official year, I visited Lahore, chiefly with a view to this object, and I there learned that a building, the property of Government, situated in a very excellent site, would shortly be vacated, and might probably be made

[1] On the 1st September 1883.

[2] I regret to report that, no reply having been received from the Home Government, and the services of the observer being urgently required by the Medical Department, it has been necessary to close the observatory.

available as an observatory and office for the Meteorological Reporter. This proposal has received the approval of the Lieutenant-Governor of the Punjab, and the building in question will be made over to the Meteorological Department in July, when steps will be taken, with as little delay as possible, to carry out the original scheme.

In the case of Allahabad, a suitable site has been obtained in the Chatham lines, and although, owing to financial considerations, it has been found necessary yet again to defer the erection of the permanent building, it is proposed to erect a temporary observatory on the spot, and commence observations for the purpose of determining the extent to which the proposed change of site will influence the normal values of the observations, especially as regards temperature and humidity. I would fain hope that this preliminary measure may be carried into effect at an early date. Every delay increases the risk of losing a sufficiently long comparative record ; in which case, much of the utility of the registers of the present observatory, now extending over nine years, will be lost to science.

REGISTRATION OF RAINFALL.—In former reports, I have given an account of the steps taken to obtain registers of rainfall from those portions of India which, up to 1881, were entirely unrepresented in the records of the Department. There were then two extensive tracts, one in the peninsular and the other in North-Western India, the rainfall of any portion of which could only be vaguely inferred from that of the surrounding regions. The first of these was the comparatively wild and inaccessible country, lying between the Central Provinces on the one hand and Chutia Nagpur, Orissa, and the Northern Circars on the other, and comprising an area of about 150,000 square miles. The other was the desert region of Western Rajputana with the Native States of Khyrpore and Bahawalpore, measuring approximately 65,000 square miles. In former reports, I have recounted the steps taken to establish raingauges in South Rewah, Sirgujah, the Tributary Mehals, the eastern districts of the Central Provinces, Bastar, Jeypore, and the zemindaries of the Northern Circars, all included in the former tract. This is now represented by the following stations :—

Chandia	in South Rewah.	Kunjabangar	in the Tributary Mehals.
Sohagpur	,, ,,	Saragaon	,, the Central Provinces.
Dudhi	,, Mirzapur.	Raigarh	,, ,,
Palamow	,, Chutia Nagpur.	Sarangarh	,, ,,
Lohardugga	,, ,,	Dhamtari	,, ,,
Sirgujah	,, Sirgujah.	Bastar	,, Bastar.
Jushpore	,, the Tributary Mehals.	Naurangapur	,, Jeypore.
Gangpur	,, ,,	Kotipad	,, ,,
Keonjhour	,, ,,	Koraput	,, ,,
Talchir	,, ,,	Malkanagiri	,, ,,
Angul	,, ,,	Gunipur	,, the Northern Circars.
Denkanal	,, ,,	Rayaghadda	,, ,,
Bispara	,, ,,	Narsapatam	,, ,,

In Western Rajputana, a thinly-peopled tract of very light and precarious rainfall, raingauges have now been established at the following stations ; at all but Bickaneer and Pachbadra, within the last year :—

Bickaneer.	Jessulmere.
Jasol.	Barmer.
Pali.	Pachbadra.
Nagar.	

In some parts of Bengal and of the Madras Presidency, where the raingauge stations sending registers to the Central Office were somewhat thinly scattered, and insufficient fairly to represent the average rainfall of the tracts in question, some additions have been made to the list, by selections from the sub-divisional stations already provided with gauges, and nearly the whole of India is now fairly well represented in the published returns.

CHART OF AVERAGE RAINFALL OF INDIA.—In last year's report, I described the chart of the average rainfall of India which had been prepared in the office and was then in the lithographer's hands. It was completed and printed in colours by December 1883, and the first copies were exhibited at the Calcutta Exhibition. Judging from the requisitions that have been received for copies of this chart, I believe that it has been found of much use by administrative officers and others.

Charts, on a smaller scale, have been prepared showing the average distribution of the rainfall in the principal seasons of the year, *viz.*, the cold season (November to February), the hot season (March to May), and the rains, but these have not as yet been lithographed.

SEISMIC OBSERVATORIES.—The registration of earthquake phenomena is a branch of terrestrial physics, but remotely connected with meteorology; but, inasmuch as it requires for its prosecution the establishment of fixed observatories, it has been found convenient to utilize certain of the existing meteorological observatories for the purpose. In 1882, in consequence of a representation from the Superintendent of the Geological Survey, a sum of Rs. 2,000 was allotted for providing a simple form of seismic apparatus and sheds for its protection, the arrangements being entrusted to the Superintendent of the Geological Survey in conjunction with myself. The iron sheds proving more costly than had been originally anticipated, the number of proposed observatories had to be reduced to three, only one of which is provided with the full set of apparatus, and the stations of Silchar, Sibsagar, and Shillong were selected for the purpose. The apparatus consisting of Mallet's cylinders and post (with bronze spheres) was constructed at the Mathematical Instrument Department. Working drawings of the shed were prepared and forwarded to the stations in question, and during the last cold weather the sheds were constructed and the apparatus set up.

When on my recent tour of inspection, I found the arrangements completed at Shillong and Silchar, and I determined the azimuths of these two observatories. That of Sibsagar was incomplete; the meridian line was however fixed, and the verification of the azimuth must be made on the next occasion of visiting the observatory.

The registers are transmitted to the Superintendent of the Geological Survey.

INSPECTION OF OBSERVATORIES.—The inspection of observatories has been adverted to, in previous reports, as one of the most important duties of the Meteorological Reporters. Thirty-three observatories have been inspected during the year by one or another of these officers, and seven by the Sanitary Commissioners of the Central Provinces and British Burmah,[1] but in the case of most of the Reporters, indeed all those who hold other offices in addition to their Reporterships, the occasions on which they are able to absent themselves from head-quarters in the performance of this duty are rare, and thus it frequently happens that observatories, the work of which is far from satisfactory and

[1] Exclusive of the five observatories at the Reporters' head-quarters.

which urgently require inspection, are left for months unvisited, owing to the inability of the local Reporter to leave his local office. In the case of stations not accessible by rail, steamer, or horse dâk, such as those in Western Rajputana and some of those in the Central Provinces, the consumption of time in the mere performance of the journey to reach them is such as to be practically prohibitive of inspection; thus it happens that Raipur, Sambalpur, Pachbadra, Quetta, Leh, Mercara, Tounghoo, and some others have never yet been visited by any Meteorological Officer; and Bickaneer, Seoni, Chanda, Dera Ismail Khan, Sibsagar, and most of the Burmese observatories have been inspected but once during the many years of their establishment. Under these circumstances, some of the local Reporters, *viz.*, Dr. Neil and his successor, Dr. Lawrie, in the Punjab, Miss Pogson in Madras, and recently Mr. Eliot in Bengal, have endeavoured to utilize the services of their head clerks to carry out the needful inspection, furnishing them with such instructions as they deem necessary, and with the guidance of some practical experience of work in a local observatory and that of the official book of instructions. Mr. Eliot and Dr. Lawrie, in their reports, both speak very favourably of the result of this measure; and I have never doubted that, when intelligent men of this class, properly coached in their duties beforehand, are so employed, they may be very serviceable. Indeed it was in this conviction that I proposed, in 1881, to add a travelling instructor to the head office, whose duties would be very similar to those actually performed by the head clerks of the offices referred to.

But it must not be supposed that, by any such measure, the Reporters can be entirely relieved of the duty of inspecting their observatories. Where, as in the majority of cases, the shortcomings of observers are due to their neglect or misapprehension of the rules laid down for their guidance, and to their departure from the prescribed routine, an intelligent head clerk or chief observer is quite able to do all that is required. But the knowledge of these men is purely empirical; and when therefore the registers of an observatory are affected by some cause or condition, not specially noticed in the official instructions, and which it requires a trained judgment to detect and estimate, only an officer of scientific experience, and with a good practical knowledge of physics, can decide wherein the work of an observatory is at fault and how it may best be remedied. And there are certain portions of an inspector's routine work, which require more experience in the details of manipulation, than men ordinarily engaged in clerical duties can well perform—such as verifying thermometers and cleaning barometer cisterns, with such appliances only as are available at the observatories.

The conclusion that I draw is this. Reporters should visit every observatory in their province once at least, and as soon after their appointment as possible. They should also inspect them subsequently, from time to time, as far as may be practicable; and only in the event of their inability to visit a station which stands in urgent need of inspection, or when the difficulty to be met is believed to be such as a subordinate officer can cope with, should such an officer be employed on the duty.

BENGAL PROVINCIAL SYSTEM OF TELEGRAPHIC REPORT.—In the latter part of 1882, a scheme was drawn up by Mr. Eliot, at the instance of the Government of Bengal, for establishing a local system of daily telegraphic weather report during the rainy season. For the information of the Provincial Government and its administrative officers, it was desired to obtain more ample information of the current phases of the weather than is

afforded by the 16 observatories which form part of the imperial system in that Province; and also to disseminate this information more rapidly and widely to the local officers, than is practicable from the Simla office. It was arranged that the additional expenditure to be incurred to the Meteorological Department should be met by an allotment of the provincial revenues, to be placed at the disposal of the Imperial Government; the general control being, like that of all other meteorological establishments, vested in the Reporter to the Government of India.

In Mr. Eliot's Administration Report (Appendix A), will be found a very full account of the measures adopted to give effect to this scheme, which came into operation, on the 15th May 1883. Twenty-two additional observatories were established in different parts of Bengal, making, together with the sixteen existing Imperial observatories, a total of 38 for the province. Of these, 31, which are in telegraphic communication with Calcutta (including the Alipore Observatory), transmit to the Bengal Office a daily telegram of the observations recorded at 10 A.M., from the 15th May to the 15th November; and these, after correction and reduction, are published daily in a tabular form, together with a general description of the weather phases of the day. The preparation of this report is completed and sent to the Bengal Secretariat Press by 4 P.M., where it is printed and distributed from the press in time for the outgoing evening mail.

In addition to the daily report of the general weather, Mr. Eliot publishes a weekly statement, giving the average and extreme variations of the meteorological elements for the week at all observatories, and the rainfall returns for the week, recorded at 166 stations. These latter are transmitted by post cards, despatched daily whenever rain is registered, and a weekly return is also forwarded as a check on the daily despatch. From a few remote stations the latter are transmitted by telegraph.

The working of the system is, therefore, accomplished with great fulness and despatch, and reflects very great credit on Mr. Eliot's administrative capacity and energy. The amount of additional personal work that it imposes on the Reporter to the Government of Bengal is very considerable, since all but the mechanical tabulation of the data falls upon him personally, and this both for the daily and weekly reports, and is an addition to the daily storm service reports, which are prepared and issued daily throughout the year. The personal work thus falling on Mr. Eliot is probably double that accomplished by any other local Reporters, not excluding those who have no other duties to discharge. And it is work of a most arduous and exacting kind. From April to November two reports have to be prepared and issued daily, without a single day's remission, and since Mr. Eliot has no assistant to relieve him of the duty, and it is carried on in an exhausting and trying climate, whether ill or well, he has still to carry through the work.

CALCUTTA EXHIBITION.—A small court in the Indian Annexe of the Calcutta International Exhibition was occupied by the Meteorological Department for the exhibition of a Van Rysselberghe meteorograph, instruments of various kinds for measuring the solar heat and the humidity of the atmosphere, and a series of meteorological charts, specially prepared for the exhibition, to illustrate the monthly variations of barometric pressure and winds of India, of temperature, and the distribution of cloud; also of the rainfall of Bengal in the rainy months, and that of the whole of India in the three principal seasons of the year and on the general average of the year; the last being the lithographed chart already referred to.

PART II.—OBSERVATORIES.

In the Report for 1882-83, I enumerated 126 observatories which contributed registers to the Meteorological Office up to the close of the year; of which number, thirteen were either independent or attached to Government Offices and not paid for by the Department, and six were private or foreign observatories. Excluding the 22 new observatories which have been established in Bengal as part of the provincial system, the only additions made during the past year are—

Kailang or Kyelang in Lahoul	(3rd class)
Seychelles Islands	(do.)

both of which had been furnished with instruments in the previous year. The first of these began to contribute registers in June 1883, the second in July 1883. Three other observatories, *viz.*, Cuddapah, and Rajahmundry in Madras, and Chamba in the N.-W. Himalaya, were furnished with instruments, but had not began to contribute registers before the end of the year.

The voluntary observatory at Paori in Kumaon having ceased to contribute registers since the 30th November 1883, the net addition to the list of observatories is one only, and at the end of the year the total number was 127. But 128 contributed registers during, at least, some part of the year. These were distributed as follow:—

Indian Empire.

Bengal and Assam	22
North-Western Provinces and Oudh	18
Punjab	12
Central Provinces	11
Berar	5
Central India and Rajputana	10
Bombay	14
Madras, Mysore, Coorg and Hyderabad	17
British Burma	8
Bay Islands	2
Lakhadives	1
TOTAL	120

Extra Indian Settlements and Foreign States.

Nepal	1
Kashmir territories	1
Baluchistan	1
Goa	1
Persian Gulf	1
Aden	1
Zanzibar	1
Seychelles	1
TOTAL	8
GRAND TOTAL	128

Of the whole number, three are first class observatories with instruments registering autographically, twenty-six second class observatories, at all but two of which, in addition to observations at 10 hours and 16 hours daily, hourly readings are registered on four

(or in some cases three) days in each month, and at all but one of these latter, synoptic observations are registered daily at 7 hours Washington mean time (=18 hours 1 minute Calcutta mean time). The remainder, with five exceptions, are third class stations, registering two full sets of observations; and, in the case of certain of the Madras stations, three sets daily. The five excepted stations, Chowringhee (Calcutta), Mongpoo, Tura, Demagiri, and Makhla, register only temperature, rainfall, and wind direction. The observatories may further be classed as—

	Class.			
	1st.	2nd.	3rd.	4th.
A.—Government observatories with paid observers under the Meteorological Department	1	25	82	1
B.—Independent observatories or attached to Government Offices, observers not paid by the Meteorological Department	1	0	7	4
C.—Private and foreign observatories	1	1	4	0
TOTAL .	3	26	93	5

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character, and an important part of the work is the working of the time signals for the port of Calcutta. It is immediately superintended by the Reporter to the Government of India, and the establishment is under the immediate charge of the Chief Observer, Babu Brojo Mohun Rukhit, B.A. During the past year, the work of the observatory has consisted of—

1st.—Continuous registration, by autographic instruments of (*a*) the duration of bright sunshine, (*b*) the atmospheric pressure, (*c*) temperature, (*d*) moisture (dry and wet bulb thermometers), (*e*) wind direction, movement and pressure, and (*f*) rainfall.

2nd.—Periodical readings, four times daily, of the barometer, dry and wet bulb thermometers, and estimates of cloud proportion; once daily of the maximum and minimum thermometers in shade, those of the exposed thermometers for nocturnal radiation and insolation; and thrice daily those of the ground thermometers at the surface, 1 foot, 3 feet, and 6 feet deep Also occasional observations on the movements of the higher clouds by means of the nephescope.

3rd.—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporter for Western India; and the comparison of all barometers with the Calcutta standard.

4th.—The determination of the mean local time, by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port. Also the custody and rating of Government chronometers.

The actinometric observations, with a Stewart's actinometer, were discontinued in February 1883, as reported at page 20 of the Report for 1882-83.

The establishment for the above purposes consists of—

Babu Brojo Mohun Rakhit, B.A.	Chief Observer.
„ Khetra Mohun Mukerjee*	1st Photo. Asst.
„ Annoda Prosaud Banerjee†	1st Photo. Asst.
„ Annoda Prosaud Banerjee*	2nd Ditto.
„ Ram Chunder Chuckerbutty‡	2nd Ditto.

* Up to 5th May 1883. † From 6th May 1883. ‡ From 1st June 1883.

Babu Mohendra Nath Banerjee . . . . . Observer.
„ Shyam Lall Sen . . . . . Ditto.
2 Artificers.
1 Batteryman.
6 Servants.

The autographic instruments consist of a sunshine recorder, the Kew barograph and thermograph, which register by photography, a Beckley's anemograph, an Osler's anemometer, and a Beckley's rain gauge. During the past year all these instruments have worked fairly well. There were, indeed, several temporary interruptions in the action of the photographic instruments, owing either to the stopping of the driving clocks, the failure of the illuminating arrangements, and, in the case of the thermograph, either to the trace running beyond the illuminated zone, when the range of temperature was very great in the hot weather, or to the drying of the muslin in the covered bulb when the evaporation was very rapid in the hot weather. All these are failures that may be avoided by proper attention, and having impressed on the chief observer the discredit that attaches to such imperfect work, I am glad to report that by increased attention to the instruments, he has succeeded, during the past month of May, in producing continuous and unbroken traces.

The following table gives a comparative view of the mean results of the autographic registers of the barograph and thermograph, and of the eye-readings of the standard barometer and shaded thermometers, recorded at the same hours. The standard barometer has the cistern about one foot higher than the barograph, and the standard thermometers are exposed under a shed open all round, while the bulbs of the thermograph are under a louvred penthouse against the north wall of the observatory :—

Comparative mean reduced readings of barograph and standard barometer in 1883.

1883.	Standard barometer.					Barograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January	30·046	30·110	29·981	30·045	30·046	30·025	30·101	29·972	30·041	30·035
February	29·964	·040	·904	29·975	29·971	29·954	·036	·901	29·974	29·966
March	·857	29·924	·790	·864	·859	·853	29·923	·790	·864	·858
April	·740	·792	·660	·744	·734	·731	·790	·657	·741	·730
May	·618	·666	·548	·630	·616	·613	·666	·545	·634	·615
June	·532	·566	·469	·552	·530	·524	·564	·463	·547	·525
July	·523	·557	·462	·547	·522	·515	·564	·465	·548	·523
August	·597	·641	·544	·629	·603	·584	·625	·528	·614	·588
September	·671	·723	·618	·707	·680	·670	·726	·617	·704	·679
October	·893	·936	·826	·893	·887	·887	·936	·822	·891	·884
November	·930	·982	·861	·935	·927	·924	·979	·858	·929	·923
December	30·062	30·128	30·007	30·076	30·068	30·051	30·121	30·001	30·071	30·061
Year	29·786	29·849	29·723	29·800	29·787	29·778	29·836	29·718	29·797	29·782

Comparative mean readings of the thermograph and dry bulb thermometer in the thermometer shed, in 1883.

1883.	Thermometer in shed.					Thermograph (dry bulb).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	54·9	68·3	74·9	60·0	64·5	56·3	67·0	73·6	60·7	64·4
February	59·4	70·7	77·8	63·7	67·9	60·4	69·7	76·5	64·6	67·8
March	69·8	80·5	87·4	75·0	78·2	70·9	79·9	86·8	75·3	78·2
April	76·1	87·0	91·5	79·6	83·6	77·4	87·0	92·0	79·9	84·1
May	80·1	88·7	91·0	82·6	85·6	81·0	89·4	91·7	83·4	86·4
June	79·8	86·2	86·8	81·1	83·5	80·7	87·1	87·4	81·7	84·2
July	79·4	84·1	84·7	80·7	82·2	80·1	84·8	85·6	81·4	83·0
August	79·1	84·0	83·6	80·5	81·8	79·8	84·6	84·5	81·1	82·5
September	79·1	84·2	84·6	80·5	82·1	79·7	84·7	85·5	81·1	82·8
October	74·3	83·4	85·9	77·2	80·2	75·2	82·9	85·8	77·9	80·5
November	61·9	74·8	79·4	65·4	70·4	62·9	73·7	78·5	66·2	70·3
December	54·9	65·7	71·9	58·3	62·7	56·1	64·8	70·9	59·2	62·8
Year	70·7	79·8	83·3	73·7	76·9	71·7	79·6	83·2	74·4	77·3

Comparative mean readings of the thermograph and wet bulb thermometer in the thermometer shed in 1883.

1883.	Wet bulb in shed.					Thermograph (wet bulb).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	53·9	60·3	61·4	57·5	58·3	54·2	59·5	61·3	57·6	58·2
February	57·2	61·1	62·4	60·2	60·2	57·6	60·8	62·6	60·6	60·4
March	68·0	71·1	70·4	71·5	70·3	68·5	71·4	71·2	71·0	70·5
April	74·7	80·3	81·1	76·1	78·1	74·9	78·7	78·4	75·7	76·9
May	77·9	80·6	80·6	78·5	79·4	78·3	81·6	81·7	78·8	80·1
June	78·1	80·3	80·1	78·0	79·1	79·0	81·1	80·8	78·7	79·9
July	77·9	79·9	80·1	78·7	79·2	78·5	80·4	80·9	79·2	79·8
August	77·7	79·5	79·5	78·3	78·8	78·1	80·2	80·3	78·7	79·3
September	77·9	79·5	79·6	78·6	78·9	78·3	80·2	80·4	79·0	79·5
October	72·7	75·6	75·5	74·4	74·6	73·3	75·7	76·1	75·2	75·1
November	59·2	64·5	65·1	62·1	62·7	60·3	64·5	65·8	62·9	63·4
December	52·9	58·2	60·3	56·2	56·9	54·0	57·9	60·0	56·4	57·1
Year	69·0	72·6	73·0	70·8	71·4	69·6	72·7	73·3	71·2	71·7

The sunshine recorder has been in constant use throughout the year, being placed on the top of the transit room building, in order to secure an unobstructed range of sky exposure. The instrument is shaded by some distant trees for about quarter hour after

sunrise and before sunset, but this is unavoidable. It is, however, of little importance, as, in the atmosphere of Calcutta, the rays that would reach the instrument during these intervals have but little heating power.

The observations of ground temperature have been steadily continued, the thermometers being read three times daily at intervals of eight hours. It has been mentioned in previous reports, that the temperature shown by the thermometer at 1 foot appeared anomalously low as compared with that of the surface on the one hand, and that of the 3 feet thermometer on the other. As a reverification of the instruments convinced me that the fault was not in the thermometer, I thought it probable that it might be due to convection within the wooden tube in which it was placed, and which left a considerable air space around the wooden block on which the instrument is mounted. To test this view, I had a second tube constructed of smaller diameter, so that by winding a strip of flannel around the instrument it nearly fitted the tube and prevented convection. This was buried side by side with the former tube, the thermometer bulb being at the same depth; and a comparison of the results, which have now been recorded more than a twelve month, has gone far to confirm my surmise. On the average of the year, the early morning reading of the new thermometer is 0·5° and the evening reading 0·3° in excess of that of the old thermometer, whereas the noon reading is 0·1° lower, indicating that, in the wide tube, the night temperature is considerably affected by the convective descent of cooled air from the upper and exposed end of the tube. This is not compensated by convection of the more heated air in the day time, as the latter, being lighter, tends to remain at the upper end of the tube.

One month before the close of the year under report, a thermometer was installed at a depth of 6 feet from the surface, the tube in this case being closed below by a copper plate, with a view to keeping out water in the rains. This is read once daily. The following table gives the mean monthly readings of all these thermometers:—

Mean temperature of ground at Alipore in 1883-84.

Months.	Surface.			1 foot deep (old).			1 foot deep (new).			3 feet deep.			6 feet deep.	Means.				
	5½ hours.	13½ hours.	21½ hours.	5½ hours.	13½ hours.	21½ hours.	5½ hours.	13½ hours.	21½ hours.	5½ hours.	13½ hours.	21½ hours.	13½ hours.	Air in shade.	Surface.	1 foot deep (old).	1 foot deep (new).	3 feet deep.
April 1883	79·0	109·9	82·9	85·0	85·4	86·5	86·1	85·5	87·4	83·7	83·9	83·9	...	83·8	90·6	85·6	86·3	83·8
May „	82·9	110·9	86·1	88·7	89·0	90·4	89·4	89·1	91·4	87·0	87·1	87·1	...	86·1	93·3	89·4	90·0	87·1
June „	82·2	97·0	83·8	87·3	87·5	88·2	87·7	87·4	88·7	87·8	87·7	87·7	...	83·9	87·7	87·7	87·9	87·7
July „	81·5	95·0	83·4	86·0	85·9	86·4	86·1	85·6	86·6	86·2	86·3	86·3	...	82·8	86·6	86·1	86·1	86·3
August „	81·8	94·7	84·0	85·9	85·8	86·2	86·0	85·6	86·5	86·3	86·3	86·3	...	82·4	86·8	86·0	86·0	86·3
September „	81·4	96·6	83·3	86·2	80·2	86·7	86·3	85·9	86·8	86·6	86·5	86·6	...	82·7	87·1	86·4	86·3	86·6
October „	76·1	96·0	78·9	83·8	83·9	84·2	84·0	83·6	84·4	85·7	85·8	85·8	...	80·1	83·7	84·0	84·0	85·8
November „	62·3	83·3	65·6	74·7	75·0	75·3	75·4	75·0	75·9	79·9	80·7	80·5	...	69·8	70·4	75·0	75·4	80·4
December „	55·4	72·0	58·9	66·1	66·4	66·8	66·9	66·3	67·2	73·1	73·6	73·4	...	62·4	62·1	66·4	66·8	73·4
January 1884	56·1	73·9	59·9	66·3	66·4	67·2	66·8	66·1	67·3	70·2	70·7	70·7	...	64·1	63·3	66·6	66·7	70·5
February „	61·0	84·0	64·5	70·1	70·3	71·3	70·8	70·1	71·5	72·5	72·8	72·9	...	68·6	69·8	70·6	70·8	72·7
March „	73·3	100·8	77·6	81·1	81·1	82·4	81·4	80·7	82·3	79·6	79·7	79·8	77·7	81·2	83·9	81·5	81·5	79·7
Means	72·8	92·8	75·7	80·1	80·2	81·0	80·6	80·1	81·3	81·6	81·8	81·8	...	77·3	80·4	80·4	80·7	81·7

The hourly readings of the surface, 1 foot and 3 feet thermometers, recorded for one month, in each of the three principal seasons (the cold season, hot season, and the rains) in 1881 and 1882, show that there is no appreciable difference between the means of the three daily readings and the true daily means of any of the three thermometers, and, therefore, the former may be accepted as valid representatives of the latter. These exhibit the same features as those of previous years, the anomalous depression of the old 1 foot thermometer above noticed being due to foreign causes. The temperature at 3 feet is, on the average of the year, 1·3° higher than that of the ground surface, and 4·4° higher than that of the air. The temperature, shown by the new 1 foot thermometer, is 0·3° higher than that of the surface, and 1° lower than that at 3 feet, therefore intermediate, and implying a rapid downward increase of temperature, which yet remains for explanation.

The number of instruments verified at the Alipore observatory, during the year ending 31st March, 1884, is as follows :—

Instruments.	No.
1. Barometers	58
2. Aneroids	6
3. Dry and wet bulb thermometers	87
4. Maximum thermometers for air temperatures	42
5. Minimum do. do. do.	61
6. Do. do. for nocturnal radiation	14
7. Solar radiation do.	16
8. Standard do.	2
9. Common do.	8
10. Sand glasses	80
TOTAL	374

and the following is a return of those received and issued by the Observatory Store Department :—

Instruments.	Received.	Issued.
1. Barometers	47	64
2. Aneroids	6	7
3. Dry and wet bulb thermometers	58	86
4. Maximum thermometers for air temperatures	21	57
5. Minimum do. do. do.	49	59
6. Do. do. for nocturnal radiation	25	31
7. Standard do.	3	4
8. Solar radiation do.	32	14
9. Common do.	8	8
10. Anemometers	1	20
11. Anemoscopes	0	8
12. Six's thermometers	6	0
13. Frankland's solar radiation thermometers	6	1
14. Sand glasses	80	78
TOTAL	342	437

The receipts and issues are considerably more than double the corresponding numbers for the previous year, which is mainly due to the requirements of the twenty-two new observatories established in Bengal for the purposes of the local system.

The time signals have worked in a far more satisfactory manner than in any previous year. Two time balls are dropped from the Alipore observatory, the one on the Semaphore Tower in Fort William, the other on the Port Commissioners' office on the Strand. The latter of these was under repair, and therefore out of work for 22 days. It dropped correctly on 264 days and failed on 1 only. The former was dropped correctly on 285 days and failed on 3 days, as shown in the tabular statement below.

A signal was given by either one or the other ball on 288 days, the remaining 78 days being either Sundays or public holidays.

Table showing the failures of the two time balls during the official year 1883-84.

Dates of failures.	Nature of failure.
5th June	Time ball on the Semaphore Tower, Fort William, failed altogether.
28th July	Time ball at the Port Commissioners' Office failed altogether.
3rd September . . .	Time ball on the Semaphore Tower, Fort William, dropped a few seconds after 1 P. M.
14th September . . .	Time ball on the Semaphore Tower, Fort William, failed altogether.

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—The twenty-two new observatories, which have been established in Bengal for the purposes of the local system of daily weather reports, furnish only one set of observations daily, and are not at present included in the imperial system. These are enumerated in the note below.[1] Excluding these, there are in Bengal and Assam 21 observatories, in addition to that of Alipore, and these are classified as follows :—

Second Class.

Sibsagar.	Hazaribagh.	Cuttack.
Dhubri.	Saugor Island.	Chittagong.
Bankipore (Patna).		

Third Class.

Darjeeling (St. Paul's School).	Gya.	Dacca.
Purneah	Berhampore.	Silchar.
Durbhanga.	Burdwan.	False Point.
	Jessore.	

Fourth Class.

Calcutta (Chowringhee).	Demagiri.	Mongpo.
	Tura.	

[1] The observatories established for the system of daily local report in Bengal are the following :—

Balasore.	Furreedpore.	Motihari.
Midnapore.	Mymensingh.	Buxar.
Ranigunge.	Rampore Beauleh.	Arrah.
Noakhally.	Dinajpore.	Dehree.
Burrisaul.	Rungpore.	Nya Doomka.
Serajgunge.	Julpigoree.	Ranchi.
Commillah.	Bhagulpore.	Chyebassa.
	Chupra.	

In Mr. Eliot's Report (Appendix A), are given the names of the superintendents and observers at all the second and third class stations, and at Demagiri and Tura. The Chowringhee observatory is attached to the Meteorological Office, the clerks of which record the observations, and Mongpo is included in the list of those which report direct to the Office of the Reporter General (Appendix E). Of the second class observatories, Mr. Eliot has inspected Sibsagar, Dhubri, and Bankipore, and I accompanied him on his visits to the two first stations, partly with a view to gaining some personal acquaintance with the physiography of Assam, which is peculiar, and a knowledge of which is requisite to the understanding of certain peculiarities in the local meteorology. Both the Assam observatories were found to be in a condition very creditable to the observers; the more creditable in the case of Sibsagar, that this observatory has never been visited previously by any Meteorological Officer. Certain of the arrangements were susceptible of some improvement, but these were such as could only be judged of by an expert. The barometer cistern was cleaned, and the thermometers reverified by comparison with a portable standard, and found to be virtually unchanged. Some further details of the results of the inspection are given in Mr. Eliot's Report.

The Bankipore (Patna) observatory, visited by Mr. Eliot alone, is also reported to be satisfactory.

Of the third class observatories, Silchar was inspected by myself, Darjeeling, Jessore, Gya, and Durbhanga by Mr. Eliot, and Dacca by the head clerk of the Bengal Meteorological Office. The Silchar observatory was more satisfactory than it had been found to be on previous occasions of its inspection, and the faults observed, such as the too great size and faulty construction of the thermometer shed, and the ricketty and unsafe condition of the anemometer and wind vane posts, are hardly chargeable on the observer. He did not indeed set his barometer very accurately, but this was partly due to the oxidized condition of the mercury in the cistern. With the exception of one of the minimum thermometers, the instruments were in good condition. The barometer and thermometers were reverified.

Silchar is the only observatory that has been supplied with the full set of seismic instruments, as noticed in the first part of this report. These had just been set up at the time of my visit, and I was therefore enabled to ascertain the exact azimuth of the observatory, and to give the observer some instruction in the use of the apparatus.

Gya and Durbhanga are unfavourably reported on, and do not furnish observations that can be accepted as trustworthy. The observations do not harmonise with those of other stations around, and it is scarcely open to doubt that the discrepancies are due to ignorance or carelessness.

Dacca has been visited by the head clerk of the Bengal Office, and its condition is not favourably reported on, several of the instruments being in a very dirty condition.

The return of instruments, broken or injured, at the observatories of Bengal, given later on in this report, speaks favourably for the general carefulness of the observers.

Self-recording anemographs are at work at Darjeeling, Dhubri, Hazaribagh, Chittagong, Saugor Island, and Cuttack, as well as at the Alipore observatory. As in previous years, the Beckley's anemographs in use at Alipore, Saugor Island, and Chittagong are far more satisfactory in their working than the Casella's anemographs at the other stations.

The following observers have been awarded special allowances during the current year, the name marked * being that of an observer now placed on the list for the first time and † indicating that the allowance has been raised from Rs. 5 to Rs. 10.

Names.	Stations.	Amounts.
		Rs.
Makhadaprosad Chowdhry	Burdwan	10
Mahendranath Roy	Berhampore	10
† Dandadhar Datta Barua	Sibsagar	10
Maniruddeen Ahmed	Dhubri	10
J. Alley	Cuttack	5
* Nathoo Lall	Hazareebagh	5

That allotted last year to Jogin Chunder Banerjee, the observer of Durbhanga, has been withdrawn.

One object of my visit to Assam was to decide on the site of the new observatory which has been sanctioned for the Assam Valley. The station of Gauhati had been originally proposed for the purpose, but was unfavourably reported on by the local officer, as being surrounded by hills. This objection proving to be well founded, Tezpur was proposed as the alternative, and an inspection of this station having proved that it is well fitted for the purpose, a site was selected on the summit of a small hill overlooking the river Brahmaputra.

I also visited Shillong, partly to inspect the seismic apparatus lately set up there, and partly to see how far it would be practicable to establish an electrical wind vane and anemometer on the summit of the Shillong ridge, to register the direction and movement of the wind across the highest part of the Khasi hills, and transmit their indications to an observatory which I propose to establish in Shillong. I find that this can be done by telegraph wires about two miles in length, and as the register will be one of very great importance, I only await the receipt of the instruments ordered some time since from England, to take further steps for establishing this observatory.

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH.—Except that the observatory, established on the voluntary system at Pauri, ceased to contribute registers after November 1883, the observatories in these provinces were the same as in the previous year, *viz.*:—

Second Class.

Allahabad.	Lucknow.
Agra	Roorkee.

Third Class.

Chakrata.	Dehra (Forest School).	Benares.
Ranikhet.	Bareilly.	Jhansi.
Mussooree (St. Fidelis).	Meerut.	Pauri.
Mussooree (S. G. Office).	Gorakhpur.	Pithoragarh.
Dehra (S. G. Office).	Ghazipur.	

Dr. Murray Thomson's report (Appendix B) gives the names of the superintendents and observers at all except the Mussooree observatories and the Forest School at Dehra. Also the results of his inspection of Roorkee, Chakrata, and Meerut (the only observatories inspected), and of an unofficial visit to Lucknow and the St. Fidelis's observatory. The Allahabad observatory, being attached to the Reporter's Office, is constantly under his eye.

In consequence of the final determination of the North-Western Provinces Government, not to establish the future 1st class observatory in connection with the Muir College, Allahabad, the comparative observations of temperature and humidity that have been carried on on that site, for the last two years, were discontinued at the end of the year under report, and the instruments have been withdrawn. The results of the two years observations are noticed in the report (Appendix B), from which it appears that the mean temperature of the College site is nearly 1° higher than that of the present observatory, and the diurnal range of temperature greater; except in the spring months, March to May. These differences are greatest in October. They confirm the conclusion drawn from the results of the Chowringhee and Alipore observatories in Calcutta, *viz.*, that whatever care be taken to render the exposure of the instruments uniform, a mere change of the site of an observatory, from one part to another of the same station, induces such a change in the average indications of the instruments, that no comparison of any value can be made between the registers, unless, by means of simultaneous registration, the effects of the change of site have been ascertained and can be eliminated.

The work of the Agra observer is unfavourably reported on, and that of the voluntary observer at St. Fidelis's School, Mussooree, still more so. As little control can be exercised over observers whose work is unremunerated, it is under consideration whether it will be better to place the observatory on the usual footing of a Government observatory and to pay the observer, on the condition of his furnishing trustworthy work, or to withdraw the instruments and close the observatory. Enquiries are being made with a view to the decision. With one temporary exception, the other observatories in the province are satisfactory.

Special allowances have been awarded for the current year to the following observers:—

Names.	Stations.	Amounts.
		₹
Chotay Lall	Lucknow	10
Kadernath Chatterjee	Allahabad	10
Jewa Nand	Ranikhet	10
Mir Altaf Ali	Agra	5
Saligram	Chakrata	5
Chirungi Lall	Roorkee	5
Devakinandan Pathak	Benares	5

The list of recipients is the same as that for the previous year.

OBSERVATORIES IN THE PUNJAB.—An additional observatory has been established in this province, *viz.*, in the Himalayan district of Kulu, at Kailang in the Chandra Bhaga valley, at an elevation of 10,000 feet above the sea-level, and the following is a complete list of the observatories of the province (not including Kashmir).

Second Class.

Lahore.

Third Class.

Mooltan.	Murree.	Kailang.
Dera Ismail Khan.	Sialkot.	Delhi.
Peshawar.	Ludhiana.	Sirsa.
Rawalpindi.	Simla.	

Kailang having been established with the special object of contributing current information on the meteorology of the mountain zone, and especially of the snowfall, reports

immediately to the general office for India; the remaining stations to the Meteorological Reporter to the Punjab Government. The names of the superintendents and observers at these latter are given in Dr. Lawrie's Report (Appendix C). Those of the Kailang observatory in Appendix E.

The observatories of Ludhiana, Simla, Delhi, and Sialkot were inspected by Dr. Lawrie, and those of Rawalpindi and Murree by myself shortly after the close of the year. The former are stated to have been found in excellent order, and the general work of the observatories to be very satisfactory. The observatory of Rawalpindi was for some years the most unsatisfactory in the province, the barometric observations, more particularly, being quite untrustworthy. Since the appointment of the present observer in November 1882, there has been a very great improvement, and during the past year, the Rawalpindi registers have been quite equal to the majority of those furnished by stations of the same class. I found the instruments in a very satisfactory condition as far as this depended on the observer, and as he could not have had any previous notice of my proposed visit, I do not doubt that such is their ordinary state.

The Murree observatory has always been favourably reported on, and its work is excellent. Indeed, the object of my visit was rather to gain an acquaintance with the position of the observatory and the local circumstances affecting the instruments than because an inspection was particularly needed. I availed myself of the opportunity to clean the barometer cisterns, both of the Rawalpindi and Murree instruments, both of which had become somewhat deteriorated with long use. Subsequently, I visited the Lahore observatory and cleaned the barometer there also.

The Lahore observatory is still at the Mayo Hospital, but its removal is urgently desired by the medical authorities; and however objectionable, as a rule, is the removal of an observatory from a site it has long occupied, in the present case it is desirable owing to the unsuitable circumstances of the present situation. But it is extremely important that the removal be made once for all, and that the future site be one that may be regarded as permanent. The chief object of my visit to Lahore was to see if this could be arranged, and I have given the results of my enquiry in the first part of this report.

The following is the list of the observers to whom special allowances have been awarded during the current year:—

Names.	Stations.	Amounts. ₹
Jaspat Rai	Lahore	5
Devan Chand	„	5
Fazul Rahman	Sirsa	5
W. Cruikshank	Murree	5
Khasi Ram	Pashawar	5
Wahid Ali	Mooltan	5

OBSERVATORIES IN THE CENTRAL PROVINCES.—As in previous years, these are eleven in number, *viz.*:—

Second Class.

Nagpur.	Jubbulpore.	Pachmarhi.

Third Class.

Saugor.	Khandwa.	Raipur.
Hoshangabad.	Chanda.	Sambalpur.
Seoni.	Sironcha.	

The names of the superintendents and observers are given in Appendix D. The Sanitary Commissioner to the Government of the Central Provinces, who exercises the local administration of the observatories, reports favourably of the observers, with the exception of the Saugor observer, Tado Rao, who absconded in March, leaving the work of the observatory for a few days in abeyance. A new barometer room has been provided at the Khandwa observatory and the barometer was moved into it on the 1st July; and at Sambalpur the observatory has been moved to a new site, the barometric observations being however still carried on at the former site for the purpose of ascertaining the amount of change in the normal values that are the consequence of the removal.

The Sanitary Commissioner has inspected the Seoni observatory and found everything in good order.

The following observers have been selected for special allowances during the current year, the sign * indicating that the present is the first time of award :—

Names.	Stations.	Amounts. ₹
T. V. Allaghiri Swami	Nagpur	10
Jadunath Bose	Hoshangabad	5
Shamsoonder Dass	Sambalpur	5
Krishna Rao*	Raipur	5
Seetaram	Chanda	5
Pancham	Seoni	5

OBSERVATORIES IN BERAR.—As in the previous years, there were five of these observatories, *viz.*, four of the third and one of the fourth class; the last established by the Forest Department, and worked without charge to the Meteorological Department, except for the supply of instruments.

Third Class.

Akola.	Chikalda.
Buldana.	Amraoti.

Fourth Class.

Makhla.

The names of the superintendents and observers of the first four are given in the return appended to Mr. Pearson's Report, Appendix F. Those of Makhla are given in Appendix E. The four third class observatories are under the general direction of the Sanitary Commissioner for Berar, conjointly with the Reporter for Western India, and transmit their registers to the Bombay Meteorological Office.

No special mention is made of the work of these observatories in Mr. Pearson's report, and it does not appear that they have been inspected by the Reporter during the past year. The barometric registers of Chikalda and Buldana no longer show the discrepancies noticed in the previous year, and, as far as can be judged, the work of all these observatories appears to be satisfactory.

The following observers have had special allowances granted to them for the current year, that newly awarded being indicated by an* :—

Names.	Stations.	Amount. Rs.
Samuel Gregory	Akola	10
Bukaram Pandurang	Amraoti	5
Hira Lall *	Chikalda	5

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—The number of these observatories also, is the same as in the previous year. The list is as follows:—

First Class.

Jeypore.

Third Class.

Sutna.	Indore.	Ajmere.
Nowgong.	Mount Abu.	Sambhar.
Neemuch.	Pachbudra.	Bickaneer.

The Maharajah's observatory at Jeypore is independent of this Department, except that it sometimes receives assistance and information, and on the other hand furnishes full copies of the registers to this office. Dr. Owen, who during the past year has superintended the observatory, has furnished a brief report on its condition and working, which is appended to that of the Reporter to the Government of the North-Western Provinces (Appendix B II). A nephescope and sun-shine recorder have been added to the instruments recorded at the observatory, the latter having been in operation since the 1st February 1884. Dr. Owen notices some difficulties that have been met with in the working of the Van Rysselberghe meteorograph, and how they have been met and overcome.

Of the remaining observatories, Sutna, Nowgong, Ajmere, and Sambhar send their registers to the Meteorological Reporter for the North-Western Provinces and Oudh, and are under that officer's administration; those of Indore, Neemuch, Mount Abu, and Bickaneer report to the Meteorological Reporter for Western India, and Pachbudra to the Central Office in Calcutta. The names of the superintendents and observers will accordingly be found respectively in the lists (Appendices B III, F II and E). The first mentioned of these officers has not inspected any of the observatories during the past year, and no special mention is made of them in his report. Those of Mount Abu, Neemuch and Indore have been visited by Mr. Pearson, whose remarks on the results of his inspection will be found in Appendix F.

At Mount Abu, the barometer was out of order and untrustworthy, but this does not appear to be due to any negligence on the part of the observer. With one exception, which, however, does seem to imply neglect of the instructions, the other instruments were in good order. The observer's work is generally well reported of.

At Neemuch some faults are noticed in the arrangement and exposure of the instruments, and their condition was by no means satisfactory. In some other respects also, the observer's work is unfavourably noticed, and he is said to be deficient in intelligence. As a special allowance was awarded to him two years since on the recommendation of Mr. F. Chambers, it has not been withdrawn, but will be so unless his work during the present year shows very great improvement.

At Indore the instruments were in good order. The observer is said to be an intelligent man, but apparently somewhat careless.

There has been a considerable improvement in the work of the Pachbudra observatory, but the registers cannot as yet be called satisfactory. Special allowances have been awarded to the following observers during the current year:—

Names.	Stations.	Amounts.
		Rs.
Ram Lall †	Bickaneer	10
Har Nath	Sutna	5
Ram Prosad	Ajmere	5
T. Bachu	Neemuch	5

OBSERVATORIES IN THE BOMBAY PRESIDENCY.—These are fourteen in number, as in the previous years; the first class observatory of Colaba being under management independent of the Meteorological Department.

First Class.

Colaba (Bombay).

Second Class.

Belgaum.	Deesa.
Poona.	Kurrachee.

Third Class.

Jacobabad.	Rajkot.	Malegaon.
Hyderabad (Sind).	Sholapur.	Ratnagiri.
Bhuj.	Surat.	Karwar.

The names of the superintendents and observers are given in Appendix F II.

The four stations of the second class have all been inspected by Mr. Pearson during the year. At Kurrachee the instruments were found to be in good condition and call for no special remark. At Deesa the majority were in good order. Some of the mechanical arrangements of the observatory were defective, and Mr. Pearson reports that there had been some difficulty in obtaining an assistant observer, Deesa being nothing but a military camp and (the native inhabitants presumably) very backward in point of education. At Poona, with one exception, the instruments were in good condition, but the apparently ineradicable habit of observing time other than that of the station was still persevered in. The Casella anemograph is more favourably reported on than is the case at most stations.

At Belgaum everything was found to be on the whole satisfactory.

Of the third class stations, Jacobabad, Hyderabad, Bhuj, Surat, Malegaon, Ratnagiri, Sholapur, and Karwar were inspected during the year; all therefore with the exception of Rajkot. The results are given in detail in Mr. Pearson's Report (Appendix F). The observers of Hyderabad and Karwar are very favourably reported on. Those of other observatories fairly well more or less, with the exception of the man in charge of the anemometer at Hyderabad and the late observer at Malegaon, Solomon Aaron, whose work is stated to have been very defective. At Jacobabad the nocturnal radiation thermometer had been improperly exposed; at Bhuj the mercury of the barometer cistern was thickly encrusted with oxide, the thermometer had too large an opening for ventilation and the raingauge had been tarred; the anemometer post too was not easy to ascend. At Surat the wind observations were very roughly made and the observer's punctuality was doubtful. The anemometer also was out of order. At Malegaon the barometer was dirty but not otherwise out of order, and the apparently discrepant character of the observations during the past three or four years, to which the attention of the Reporter had been drawn, must therefore have been due to some fault of the observer. The anemometer was worn and worked stiffly. At Ratnagiri everything was in good order, except that the anemograph tower was not weather proof. At Sholapur the observatory is retained at its old side. It had been proposed to remove it to the Electric Telegraph Office, and arrangements were in progress for this purpose, but the step has been postponed, as it is doubtful whether the Electric Telegraph Office will long be retained at its

present site. The barometric readings during a part of December were incorrect and had to be rejected. At Karwar every thing was in good condition; this has hitherto been a voluntary observatory, but application having lately been made for an allowance to the observer, and granted, it will henceforth rank on the regular list of Government observatories under the Department.

The following is the list of observers in the Bombay Presidency to whom special allowances have been awarded for the current year :—

Names.	Stations.	Amounts. Rs.
Mahadev Cuddum	Ratnagiri	5
Narayen Sakaram	Poona	5

OBSERVATORIES IN MADRAS, MYSORE, COORG, AND HYDERABAD.—Of the three additional observatories in Madras, sanctioned in October 1881, that of Kurnool was established in 1882, that of Cuddapah a few days before the close of the year under report, *viz.*, in March 1884, and the third only since its expiration. There were therefore eighteen observatories in these provinces in 1883-84, of which three were of the second class, *viz.* :—

Second Class.

Vizagapatam.	Bellary.	Trichinopoly.

Third Class.

Gopalpore.	Madras.	Madura.
Masulipatam.	Bangalore.	Cochin.
Secunderabad.	Negapatam.	Wellington.
Kurnool.	Salem.	Mercara.
Cuddapah.	Coimbatore.	Mangalore.

With the exception of Vizagapatam, which is the private observatory of Mr. A. V. Nursingrow, and Gopalpore, which was established for the purposes of the Bengal system of storm-warnings, all the above are under the administration of the Meteorological Reporter to the Government of Madras, extracts from whose report are given in Appendix G. A nominal list of the superintendents and observers is also appended (G II).

Miss Pogson reports that three of the observatories, *viz.*, Bellary, Cuddapah, and Secunderabad, were inspected by her during the past year. The Bellary observatory was found to be in fair condition, although susceptible of improvement in many points of detail, and complaint is made of great delay in the transmission of the registers to the Madras Office. Cuddapah being a newly established observatory, nothing can be said as to the work of the observer. The position is reported to be good, and the general arrangements satisfactory. The general condition of the Secunderabad observatory was found to be very satisfactory and highly creditable both to the superintendent and the observer, and it is remarked that this observatory, formerly the worst, now ranks as one of the best in the Presidency.

Of the second class observatory at Trichinopoly, complaint is made of "the obstinacy of the assistants" in not forwarding their reduced registers till many months after they are due. It does not appear, however, that recourse has been had to any other means of enforcing obedience than simple remonstrance, which could be ignored with impunity. The only other observatory at which the observer has given serious cause for complaint is Masulipatam. Under the direction of this office, this man was reduced to

half pay in March last, but even this measure has failed to bring about any improvement, and his further services will be dispensed with shortly. The barometric returns of this station have long been untrustworthy, but it is uncertain whether this is not due to some accidental injury suffered by the instrument in transport. At Cochin the anemometric registers are quite valueless, which appears to be due, partly at least, to the faulty position of the anemometer.

At the remaining observatories there has been nothing calling for remark. Miss Pogson reports that their general work has been satisfactory during the year, and that there has been much improvement in the work of reducing the observations, which is required of all observers who draw the high rate of salary sanctioned for the old observatories in Madras, but in no other part of India.

OBSERVATORIES IN BRITISH BURMA.—The observatories in British Burma are eight in number, as in previous years, *viz.*, Akyab under the general direction of the Bengal Reporter, and noticed in his report; Diamond Island under the Central Office, and the remaining six enumerated in the following list under the immediate direction of the Sanitary Commissioner of British Burma.

Second Class.

Rangoon.

Third Class.

Bassein.	Thyetmio.	Tounghoo.
Diamond Island.	Mergui.	Moulmein.
Akyab.		

Lists of the superintendents and observers during the past year are given in Appendices A, E, and H I.

The report of the Sanitary Commissioner on the condition of his observatories is given in Appendix H. He has inspected all of the six observatories under his local administration, and found them to be generally in satisfactory condition. Rangoon during the greater part of the year sent up registers as full of errors as in the previous year. The errors were, however, chiefly in the computation of the results. The observational work, if not quite satisfactory, appears from such tests as can be applied, less open to condemnation.

No special reference is made to the work of the Akyab observatory in Mr. Eliot's report, and it may therefore be inferred that he has no reason to repeat the unfavourable remarks made in his report of the previous year. The observatory of Diamond Island, which like that of Akyab is attached to the Electric Telegraph Office, has worked satisfactorily as far as can be judged from the registers.

The observatories of Bassein, Thyetmio, and Tounghoo have been better during the past year, but the barometric observations of the last two have been frequently of doubtful validity and do not appear to accord with those of other observatories. The site of the Tounghoo observatory has been changed during the year. The barometer at Moulmein appears in some months to be unduly low.

The majority of the Burmese observatories have generally ranked below those of other Provinces. Whether this be due to the fact of an inferior class of men being appointed as observers in Burma, or to other causes, it is difficult to say. But the fact is unquestionable.

A special allowance has been continued to the only observer in the Province who has been found deserving of it, *viz.*:—

Name.	Station.	Amount.
		Rs.
P. H. Hilbert	Moulmein	5

OBSERVATORIES AT THE BAY ISLANDS.—These, as in former years, are two, *viz.*:—

Third Class.

Port Blair (Andamans). | Nancowry (Nicobars).

The names of superintendents and observers are given in Appendix E.

Port Blair has worked satisfactorily during the past year. It is extremely important, owing to its proximity to the cyclone cradle, and, as was shown on a recent occasion, might be of much greater utility were it in telegraphic connection with the Indian mainland, as information could then be obtained of the formation of cyclones one or two days, and in some cases probably three or four days, earlier than at present. Nancowry furnished unsatisfactory registers during the first half of the year under report, and it became necessary to withhold a portion of the allowance, but since September the work has been satisfactory.

The special allowance awarded during the last two years has been continued to—

Name.	Station.	Amount.
		Rs.
J. F. Peters. . . .	Port Blair. . . .	5

EXTRA INDIAN OBSERVATORIES.—An addition has been made to the working extra Indian observatories during the past year, in that established at Victoria in the Island Mahé of the Seychelles. They are now eight in number, *viz.*:

Second Class.

Leh. | Aden. | Zanzibar.

Third Class.

Bushire. | Amini Divi (Lakhadives).
Quetta. | Mahé (Seychelles).
Katmandu.

The names of the superintendents and observers are given in Appendix E, with the exception of those of Leh, which should be included in the list of the Punjab stations, and those of Zanzibar, which appear in the list accompanying the report of the Reporter for Western India.

The work of the observatories of Zanzibar and the Seychelles has already been noticed in the first part of this report, also the unsatisfactory results of the Amini Divi observatory, which is controlled by the Meteorological Reporter to the Madras Government.

The Leh observatory is not particularly mentioned in the Punjab report (Appendix C), but I have reason to believe that it has continued to work as satisfactorily as in previous years. I regret to learn that the Assistant Observer Bhola, whose excellent work under Dr. Scully in Yarkand has been prominently noticed in the publications of the Meteoro-

logical Office, has lost his appointment at the Leh observatory owing to his prolonged absence without leave. The meteorological observatory at this station remains independent of the actinometric observatory, which commenced work in November 1883, but it was left under the general superintendence of the Actinometric Observer, Sergeant Rowland, throughout the past winter, during the absence of the British Joint Commissioner.

The work of the Katmandu observatory has not been satisfactory. For several months in succession the registers had to be returned for correction, and owing to the observer's neglect of official instructions, some portions have had to be rejected as valueless.

The Aden observatory has hardly been so good as in previous years. The superintendent has found it difficult, if not impracticable, to obtain a competent observer at the rate of pay which is found sufficient in India, and it is now proposed to reduce Aden to a third class observatory, in which case the observations can be taken by the head clerk of the superintendent's office.

The Quetta registers have been satisfactory, as far as can be judged from internal evidence.

INSTRUMENTS.

In Appendix I, is given a return of the instruments in store at the beginning of the year, and of those received and issued by the Calcutta Meteorological Office, and includes the stock, receipts and issues of the Alipore observatory; and in Appendix K is a return of the instruments issued to each observatory. In this are incorporated the returns furnished by the local Reporters.

METEOROLOGICAL OFFICES AND OFFICE WORK.

The general control of the meteorological observatories and offices in the different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the year.

Name.	Office.	Provinces.
John Eliot, M.A. A. Pedler, Esq. (Offg.)	Meteorological Reporter to the Government of Bengal	Bengal and Assam.
S. A. Hill, B.Sc. Dr. Murray Thomson (Offg.)	Meteorological Reporter, North-Western Provinces and Oudh	North-Western Provinces, Oudh, Rajputana, and Central India (part).
Dr. E. Lawrie	Meteorological Reporter, Government of Punjab	Punjab and Kashmir.
A. N. Pearson, Esq. (Offg.)	Meteorological Reporter for Western India	Bombay, Berar, Rajputana, and Central India (part).
Miss Isis Pogson	Meteorological Reporter to Government of Madras	Madras, Mysore, and Hyderabad.
Dr. W. Watson. Dr. J. H. Loch	Sanitary Commissioner, Central Provinces	Central Provinces.
Dr. Little	Sanitary Commissioner, Berar	Berar.
Dr. D. Sinclair	Sanitary Commissioner, British Burma	Burma.
Surgeon J. Reid	Senior Medical Officer, Bay Settlements	Andamans and Nicobars.

Mr. Eliot was absent on privilege leave during the months of August, September, and October, during which Mr. Pedler officiated as Meteorological Reporter to the Government of Bengal.

Mr. S. A. Hill left on furlough on the 20th May 1883, making over the charge of his office to Dr. Murray Thomson, who officiated up to the end of the year.

Mr. F. Chambers returned from leave on the 6th June, and took over charge of his appointment from Mr. Pearson; but on the 18th idem, having been appointed to officiate as Superintendent of the Colaba observatory, Mr. Pearson resumed the Reportership for Western India, and continued in that charge till the close of the year under report.

In the Punjab and Madras the permanent incumbents remained in charge of their respective offices.

The following table shows the number of stations, the registers of which were sent to each of the reporters respectively for reduction and verification during the year under report :—

PROVINCES.	METEOROLOGICAL REPORTERS.						TOTAL.
	India.	Bengal.	North-Western Provinces and Oudh.	Punjab.	Western India.	Madras.	
Bengal and Assam	3	19	...	...	...	...	22
North-Western Provinces and Oudh	1	15	...	...	...	...	16
Punjab	1	...	...	11	...	...	12
Rajputana and Central India	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay	...	...	...	...	13	...	13
Madras, Mysore, and Coorg	1	1	...	...	...	15	17
Burma	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	6	...	...	...	1	1	8
TOTAL	34	21	19	11	22	16	123

This list does not include the registers of the Colaba observatory and of Jeypore, which are furnished to the Meteorological Office with all the necessary reductions with a partial exception in the case of Colaba. The observatory at Goa only sends telegraphic reports.

In Bengal, the North-Western Provinces, and in Bombay (partly) the Reporters superintend the rainfall registers of the district and subdivisional stations of their respective provinces, and prepare weekly and monthly returns of the rainfall, *viz.* :—

	Stations.
Bengal	167
North-Western Provinces and Oudh	253
Bombay (partially) over	400

The Bengal and Bombay Reporters also administer a system of storm warnings for the protection of the local ports; and the Bengal Reporter has had during the last year, in addition to the above, the working of the system of daily telegraphic weather reports (from the 15th May to the 15th November), which has already been noticed in the first part of this report. He also administers that department of the Central Office which deals with the current meteorology of the Bay of Bengal, and collects the meteorological observations from the log-books of ships entering the Port of Calcutta.

Mr. Dallas, Assistant Meteorological Reporter to the Government of India, has continued in charge of the Imperial system of daily weather reports, which, during the last year, were issued at Simla from the 16th May to the 15th November, and at Calcutta up to 15th May and from the 16th November to the 31st March. He also prepared monthly and semi-annual summaries of the weather reports, and is engaged in the reduction of the marine observations received from the London Meteorological Office, and in the preparation of weather charts of the Bay of Bengal, and the sea southward as far as the equator. The charts showing the barometric pressure and the wind directions for the first eight months of the year are now complete.

OFFICE ESTABLISHMENT.—The following is a return of the number of permanent employés in the offices of the several Meteorological Reporters:—

	India.	Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	TOTAL.
Head Clerks	1	1	1	1	1	1	6
Computers	3	...	...	...	1	...	4
Clerks and Copyists	3	2	1	2	...	3	11
Tabulators	18*	7	4	...	5	...	34
Draughtsmen	3	1	...	...	...	...	4
Artisans	...	3	...	...	...	...	3
Peons and Menials	10	4	2	1	2	1	20

The Central Office has remained under the charge of the Head Clerk, Babu Fanindra Mohun Basu, during the past year, and, I am glad to report, with the same satisfactory results as in previous years. The head clerk of the Bengal Meteorological Office, Babu Chandi Churn Chatterji, is reported by Mr. Eliot to be a most efficient head clerk. The Meteorological Reporter for the Punjab also speaks well of the services of the chief observer and head clerk of his office, Jasput Rai.

Four tabulators and a draughtsman were added to the Bengal Office at the beginning of the year under report, for the purposes of the provincial system of daily weather report; and three or four clerks had to be entertained temporarily, in addition to the above, from the 15th May to the 15th November. One man has been added to each of

* Besides these, there are four temporary clerks for reducing the London Meteorological Office marine logs

the offices of the Reporters to the Governments of the North-Western Provinces, the Punjab, and Madras.

WEATHER BULLETINS AND STORM SIGNAL SERVICE.—The daily weather reports of the Imperial office were issued at Simla from the 16th May to the 15th November, and at Calcutta during the remainder of the year. They now give the 10 A.M. observations of the principal meteorological elements of 96 stations, together with the maximum and minimum temperatures, the average wind movement, the rainfall and the general weather of the preceding 24 hours; and, in the rainy season, the rainfall of 28 additional stations. The tabulated observations, with general remarks on the weather of the day, are sent to press at 5 P.M. daily, and the printed sheets are distributed on the following morning. The verbal summary is telegraphed at 5 P.M. daily to the seats of the Provincial Governments, and copies are sent to the Allahabad and Calcutta newspapers.

An independent provincial system of daily weather reports, giving the observations at 10 A.M. of 31 stations, was organised at the beginning of the past year by the Meteorological Reporter to the Government of Bengal, at the cost of the Local Government. It is in operation from the 15th May to the 15th November. The telegrams are received as urgent, and the daily report, including a verbal description of the weather, is sent to the Bengal Secretariat Press at 4 P.M. daily, and printed and distributed from the press in time for the evening mails. A full description of the working of this system is given in Mr. Eliot's report (Appendix A).

The Bengal system of daily weather reports, based on telegrams received as "urgent" from 17 stations around the coasts of Bay of the Bengal, which forms part of the storm warning service, is independent of the above. This is carried on throughout the year, the daily bulletin, illustrated by a chart of the Bay, being lithographed in the office and distributed by peons or through the afternoon post.

The past year was a stormy year at the head of the Bay of Bengal, not less than ten storms being recorded in Mr Eliot's report. They were all small storms, and with the exception of the second on the list, *viz.*, that of June 26th to July 4th, did not appear to warrant the hoisting of the storm signals.

The working of the storm signal serve of the Bombay coasts is noticed in Mr. Pearson's report (Appendix F). The daily reports of the ten stations which transmit telegrams are not printed for the Bombay Meteorological Office, but a manuscript copy is posted at the office and another sent to the *Times of India*, and an abstract to the Bombay Gazette. Only one storm occurred during the year, of sufficient importance to justify the hoisting of the storm signals, *viz.*, the same storm for which the signals were hoisted in Bengal. This storm crossed the peninsula, its daily progress being reported in the Simla weather reports, and also telegraphed from Simla to Bombay. The working of the Bombay system has been expedited by connecting the Meteorological Office with the Telegraph Office by telephone.

WEEKLY, MONTHLY, AND SEMI-ANNUAL REPORTS.—From May to October, both inclusive, a monthly descriptive summary of the chief weather characteristics of the month, based on the telegraphic reports, was prepared in the Simla Office, and published in the Gazette; and in May and November, a general summary of the Indian meteoro-

logy of the preceding six months was drawn up and published in like manner. Appended to the summary of the six months November 1882 to April 1883, published in the *Gazette of India* on the 2nd June, was a note in which, after adverting to the distribution and amount of the Himalayan snows in the preceding winter and spring, the conclusion was announced that if the views "that an unusual extent and thickness of snow on the Himalaya is productive of dry north-west and west winds in India are valid, we must be prepared for a long spell of dry weather and a retarded rainfall in the Upper Provinces." This is the first time that the office has ventured to base a prediction on the facts of the snowfall, or indeed on any other foundation than a general resemblance of the weather of the earlier months of the year to that of the corresponding season of some previous year. The result was therefore awaited with much interest. This result was given in a note appended to the next semi-annual weather report, published in November. It was not in exact accordance with the terms of the above forecast, inasmuch as the setting in of the rains in the Upper Provinces took place only a few days later than on the average, and rather more than a fortnight of rainy weather preceded the period of drought, which had been foreseen, and which set in on the 19th July. After this date, the north-west current, which had existed throughout at no great height above the hills of the outer Himalaya, "descended and replaced the monsoon, prevailing over the whole of North-Western India and Rajputana, and influencing the winds, even down to the Deccan on the south and to Behar on the east." The final conclusion was drawn that "the experience of the present season has given strong confirmation of the validity of the view on which the forecast was based." Some further notice of this subject has already been given in Part I of this report.

In Bengal, a weekly meteorological and rainfall statement has been published by the Reporter, and also a monthly meteorological and rainfall statement, giving the averages of 44 observatories, and a complete statement of the daily rainfall during the month, at 166 raingauge stations. Both these periodical issues are accompanied by a full verbal description of the general results.

No mention is made in Dr. Murray Thomson's report of the periodical publications of the North-Western Provinces Office, probably because they were of the same character as in preceding years.

In Bombay, monthly abstracts of the results of the observatories have been published in the Government Gazette as in previous years.

ANNUAL REPORTS.—The report on the meteorology of the year 1882 was complete, and in the printer's hands before the end of December 1883, and it was submitted to Government in its complete form on the 14th July 1884. The printing of the text was completed in April, but the issue was again delayed by the preparation of the plates, a delay which was extended by the loss of the set first prepared by the draughtsman, and the consequent necessity of reproducing them.

The report gives tables of temperature for 130 stations, and rainfall returns of 457 stations, being a decrease of one of the former, and an increase of 40 of the latter, on the numbers respectively given in the report of the previous year, in the corresponding tables. The returns of pressure, wind direction and other meteorological elements are nearly as numerous as those of temperature. The elements tabulated in the Appendices are as

follow. I give for comparison the number of registers summarised in the corresponding tables of the reports of the four previous years :—

	Number of Stations.				
	1878.	1879.	1880.	1881.	1882.
Equilibrium temperatures of solar radiation	99	106	109	106	112
Temperature of nocturnal radiation	97	100	108	106	104
Temperature of the ground	...	...	2	4	4
Mean and extreme air temperatures	116	123	126	131	130
Sea-level equivalents of mean temperature	100	101	105	108	108
Means and extremes of atmospheric pressure	113	119	122	125	124
Sea-level equivalents of mean atmospheric pressure	96	98	105	107	108
Direction and movement of winds	113	118	124	127	125
Temperature of evaporation	106	111	115	121	120
Tension of atmospheric vapour	113	120	123	128	127
Mean relative humidity	114	120	123	128	127
Mean proportion of clouded sky	110	118	122	125	124
Inches of rainfall in each month	253	365	399	417	457
Number of days on which rainfall was measured	276	365	379	403	457

The descriptive letter press discusses the chief characteristics of the meteorology of the year. It includes 27 numbered tables, giving the average values of all the more important elements, for all stations that have furnished returns for three years and upwards; and the report is illustrated with 8 plates, of which one is a chart showing the position of all Indian observatories and raingauge stations; three, in coloured lithography, represent the average distribution of temperature, pressure and winds in each month of the year; and the remainder illustrate particular phases of weather, *viz.*, certain instances of rainfall in the cold weather; the progress of a monsoon storm across Bengal; the conditions accompanying a break in the rains in August; and the progress of a cyclone in October. This last has been made the subject of a detailed investigation, the results of which have been embodied in a memoir by Mr. Eliot which is now in the press.

The original observations of six observatories, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras, were issued as a distinct publication in monthly parts, and form a small quarto volume, the fourth of the series, which was issued in a complete form in October 1883. Those for 1883, the fifth volume of the series, was issued in May 1884.

A report on the rainfall of the North-Western Provinces in 1883, was compiled in the Office of the Meteorological Reporter for the North-Western Provinces, and published in the Government Gazette of the 29th March last; and one on the meteorology of the North-Western Provinces in 1882-83 was prepared by Mr. S. A. Hill and printed and distributed before his departure on leave.

Mr. Pearson also prepared a brief sketch of the meteorology of the Bombay Presidency in 1882-83.

MISCELLANEOUS PUBLICATIONS.—Part II of the second volume of the Indian Meteorological Memoirs was issued in November 1883. It contains a memoir by myself on the storms of the west coast and on the land formed cyclone of Gujarat of July 1881, and a very important paper by Mr. Hill on the normal temperature of Northern India, illustrated by a series of isothermal charts for the year and for each month.

Another publication of the office is the chart of the average rainfall of India, which has been already noticed in the Administration Report for last year, and briefly in Part I of the present report.

A paper was communicated to the March meeting of the Asiatic Society of Bengal on the "Theory of the cold weather rains of Northern India," and will shortly be published in the Society's Journal; and another paper "On the connection of the Himalayan snowfall with dry winds and seasons of drought in India" was read before the meeting of the Royal Society on the 1st May 1884.

Dr. Murray Thomson mentions the preparation of a new edition of Mr. Hill's paper (published in 1879). "On the rainfall of the North-Western Provinces and Oudh," and Mr. Pearson that of a paper communicated to the Royal Meteorological Society of London on "Some results of an examination of the barometric variation in Western India."

Appendix L gives a list of the Government officials, libraries, observatories, societies, &c., to which the publications of this office are presented, including those which send their own publications in exchange.

LIBRARY.

The library is contained in six large double book-cases, and is in excellent condition; but owing to the want of space in the office, the book-cases are sufficient only for the preservation of the books. Any systematic arrangement, according to subject-matter, is impossible; and the book-cases are distributed in different parts of the office building. It will be impossible to effect a proper re-arrangement, and to render the library useful for general reference, until the office is removed to a much larger building.

A list of the additions to the library is given in Appendix M.

HENRY F. BLANFORD,

Meteorological Reporter to the Government of India.

SIMLA:
The 22nd July 1884.

APPENDIX A.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Bengal for the year 1883-84.

THE Bengal Meteorological Department was under my control during the whole of the past official year, except the months of August, September, and October, when I was absent on privilege leave. Mr. Alexander Pedler, who had acted previously for me on four occasions, was again appointed to officiate as Meteorological Reporter during my absence.

During the past year, the extensions of the Bengal Meteorological Department, which were proposed and sanctioned during the preceding year, and the character, extent, and scope of which were stated in my Administration Report for the year 1882-83, were completely and successfully effected. The past year has hence been one of considerable importance in the working of this department, and it seems desirable to place on record a statement of the manner in which the proposed extensions were carried into effect during the year.

The proposals which were finally sanctioned in March 1883 by the Government of India, at the request of the Government of Bengal, authorised and provided for a number of changes, of which the following were the most important :—

1st.—The establishment of a large number of additional stations, recording observations at 10 A.M. only, to be distributed throughout the province in such a way as to give a fairly complete view of all the more important meteorological changes in the province.

2nd.—Provision for additional inspection of the observatories at all seasons of the year, so that the source of any error in the observations detected by the examination of the returns sent to the office might be immediately traced, if necessary, by a visit of an inspecting officer to the observatory. By this means errors, whether due to instrumental changes, or to carelessness, or ignorance, or other defects on the part of the observer, might be speedily rectified, and the accumulation of inaccurate observations prevented.

3rd.—Special arrangements for the speedy and continuous transmission of the meteorological and rainfall observations taken throughout the province, day by day, to the Bengal Meteorological Office, where they may be at once reduced and tabulated, and the various meteorological returns be prepared for publication without any unnecessary delay.

4th.—The publication of daily weather reports for the province of Bengal during the south-west monsoon, or from May 15th to November 15th, and of weekly and monthly meteorological and rainfall returns in the *Calcutta Gazette*, with short summaries giving the more important features of the weather and rainfall for the period in question, and their distribution to district officers and certain officers in the Irrigation, Public Works, and other departments.

5th.—An increase in the number of clerks in the Bengal Meteorological Office in order to enable the additional work to be performed fully, accurately, and rapidly. A considerable increase was necessary, in order not merely to deal with the larger number of observations transmitted to this office, in consequence of the increased number of observatories, but also to bring up and to maintain the whole of the office work up to date, and to go through the whole of the observations taken at the older established stations, and obtain daily and weekly means of the elements of meteorological observation, in order to enable the peculiarities of the weather for any period in discussion to be stated quantitatively as deviations from the normal or average conditions for that period.

The scheme in its final and complete form was submitted by the Government of Bengal to the Government of India on the 29th January, 1883, and sanction was granted by the Government of

India on terms which were accepted by the Government of Bengal. These terms were in effect that the Bengal Government should contribute a sum from its provincial funds equal to the estimated cost of the extensions to the Imperial Meteorological grant, and that the money should be expended in carrying out the proposals of the Government of Bengal, but that the control and supervision of the additional observatories should be exercised by the Meteorological Reporter to the Government of India. The effect of this is that the whole of the observatories now established in Bengal are, as before, subject to the control and orders of the Imperial Reporter, and the working of every part of the system is under his supervision. This arrangement has been perfectly satisfactory during the past year. It has secured on the one hand the extension of the department, which was considered essential by the Government of Bengal, whilst it has maintained uniformity of system and control by a single head—most important features in a scientific department, such as a Meteorological Department is or ought to be.

Establishment of additional observatories.—The stations at which it was finally decided to establish observatories were as follows :—

Orissa	Balasore.
South-West Bengal	Midnapore. Ranigunge.
East Bengal	Noakholly. Burrisaul. Serajgunge. Commillah. Furreedpore. Mymensigh.
North Bengal	Rampore Beauleah. Dinagepore. Rungpore. Julpigoree.
Behar	Bhagulpore. Chupra. Motihari. Buxar. Arrah. Dehree.
Sonthal Pergunnahs and Chutia Nagpur	Nya Doomka. Ranchi Chyebassa.

It was originally intended to establish and work these observatories entirely through the agency of the Public Works Department, but this was found to be in a few cases (*viz.*, Serajgunge, Chyebassa, Ranigunge, and Nya Doomka) impracticable.

As soon as the letter of the Government of India sanctioning the proposals was received (March 15th, 1883), instructions were issued by the Secretary to the Government of Bengal, Public Works Department, to the Executive Engineers in whose divisions the stations selected for observatories were situated, requesting them to choose sites and arrange for the early construction of sheds and the selection of suitable officers in the establishment of the Public Works to take the observations. Copies of plans of the pattern thermometer shed approved and adopted by the Meteorological Reporter to the Government of India were sent, and a few rules for guidance in the selection of a suitable site. It was originally intended to commence the work of observation under the new system from the 1st of April, but this was, of course, not possible, in consequence of the sanction of the scheme by the Government of India not being received until nearly the end of March. As early erection of the sheds and the establishment of the observatories was an imperative necessity, in order to commence the publication of the Bengal Daily Weather Reports on the 15th May, it was

necessary to leave the selection of sites entirely to the judgment of the Executive Engineers or their subordinates. In the great majority of cases very suitable sites were chosen, and the sheds erected as rapidly as could be expected under the circumstances. In one or two cases unexpected difficulties arose in obtaining well exposed sites, the local authorities opposing the erection of the shed. In one case, the Executive Engineer, after the shed had been built on a suitable site, was ordered by the Commissioner of the Division to take it down and re-erect it on a distant and much more objectionable site.

The following table gives the dates on which observations were first taken and transmitted to the Bengal Meteorological Office at the newly established observatories :—

Meteorological Division.	Station.	Date of commencement.
Orissa	Balasore	22nd May 1883.
South-West Bengal	Midnapore	1st June ,,
	Ranigunge	10th June ,,
East Bengal	Noakholly	3rd August ,,
	Burrisaul	2nd July ,,
	Serajgunge	4th August ,,
	Commillah	1st June ,,
	Furreedpore	5th July ,,
	Mymensingh	18th June ,,
North Bengal	Rampore Beauleah	27th August ,,
	Dinagepore	20th May ,,
	Rungpore	22nd May ,,
	Julpigoree	15th May ,,
Behar	Bhagulpore	4th June ,,
	Chupra	8th June ,,
	Motihari	30th May ,,
	Buxar	3rd June ,,
	Arrah	21st July ,,
	Dehree	4th June ,,
Sonthal Pergunnahs and Chutia Nagpur.	Nya Doomka	5th July ,,
	Ranchi	11th July ,,
	Chyebassa	21st August ,,

Inspection of observatories.—This is, as I have frequently pointed out, of the utmost importance, in order to secure continuous accuracy of observation. It is the one part of my duties as Provincial Reporter which I can only perform during the cold weather vacation. In consequence of the changes in the college vacations recently introduced, I shall have less opportunity than previously of inspecting observatories. I proposed last year that an inspecting officer should be sanctioned, who should perform the combined duties of draughtsman and inspecting officer. A passed student was

obtained from the Thomason Engineering College, Roorkee. It was, however, found that his time was so fully occupied with the preparation of the ordinary and the additional rainfall charts (which I submitted to the Government during the course of the south-west monsoon), that it became necessary to propose another arrangement. Advantage was taken of his transfer to the Office of the Executive Engineer, Cawnpore, to appoint a draughtsman on a slightly lower salary, and I applied to Government to sanction the transferrence of the amount saved to increase the pay of the head clerk, on condition that he assisted me in the work of inspection. This arrangement was approved by Government. As it is inconvenient for both the head clerk and myself to be absent at the same time, I was only able to take him with me on inspection to a single observatory. After the termination of my cold weather vacation, I sent him to inspect the observatories in Eastern Bengal. He did this in so efficient a manner, as to fully satisfy me of his ability and capacity to perform the duties of inspecting officer. He will thus in future be of valuable assistance, and enable me to secure the inspection of any observatory at any time that it may seem necessary or desirable.

The work of inspection during the past year was almost entirely confined to the cold weather period—November to March. The amount of inspection done will show the value of this new arrangement. The following stations were inspected by myself:—

Station.	Dates.
Dhubri	December, 14th and 15th.
Gauhati	ditto, 27th and 28th.
Tezpur	ditto, 24th.
Sibsagar	ditto, 20th to 22nd.
Rungpore	January, 2nd, 1884.
Darjeeling	ditto, 4th.
Julpigoree	ditto, 6th.
Patna	November, 23rd.
Motihari	ditto, 21st and 22nd.
Bhagulpore	November, 17th and 18th.
Chupra	December, 5th and 6th.
Durbhunga	November, 20th.
Nya Doomka	ditto, 26th.
Buxar	December, 7th.
Arrah	ditto, 4th and 5th.
Ranigunge	ditto, 2nd and 3rd, and June, 23rd and 24th.

and the following by my head clerk:—

Station.	Dates.
Julpigoree	January, 6th.
Dinagepore	ditto, 8th.
Rampore Beauleah	ditto, 10th and 11th.
Serajgunge	February, 20th, 21st, and 22nd.
Mymensingh	ditto, 25th, 26th, and 27th.
Dacca	ditto, 13th.
Furreedpore	February, 16th.
Burrisaul	January, 31st, and February, 1st.
Commillah	February, 9th.
Noakholly	ditto, 6th.
Gya	March, 25th and 26th.
Dehree	ditto, 22nd.

Arrangements for transmission of the observations to the Central Office.—The methods I proposed to employ for the regular transmission of the meteorological and rainfall observations were given in the last Administration Report.

The 10 A.M. observations, taken at the various meteorological stations, are forwarded daily to the office in various ways, according to the position of the observatory with respect to telegraphic and postal communication and the purposes for which the observations are utilized.

Urgent telegrams are sent daily throughout the whole year by the following stations. These are required for the Bay of Bengal Weather Report:—

Saugor Island.	Dacca.	Cuttack.
Balasore.	Chittagong.	False Point.

Similar telegrams are also sent by the following stations which are not in Bengal:—

Diamond Island.	Vizagapatam.	Madras.
Akyab.	Coconada.	Nagapatam.
Gopalpore.	Masulipatam.	Trincomalee.
	Galle.	

The following stations send urgent or ordinary telegrams during the period, 15th May to 15th November, when the 10 A.M. observations are required for the compilation of the Bengal Weather Report :—

Mymensingh.	Durbhunga.	Bhagulpore.
Commillah.	Motihari.	Patna.
Serajgunge.	Chuprah.	Arrah.
Rungpore.	Midnapur.	Buxar.
Dinagepore.	Burdwan.	Dehree.
Julpigoree.	Ranigunge.	Gya.
Darjeeling.	Jessore.	Hazaribagh.
Purneah.	Rampur Beauleah.	

The remaining observatories are at stations to which telegraphic communication has not yet been extended; hence they can only transmit their observations by post. These are—

Ranchi.	Burrisaul.	Furreedpore.
Chyebassa.	Noakholly.	Berhampore.
	Nya Doomka.	

Those stations, which forward weather telegrams, also transmit by post copies of the observations sent by telegraph, so that errors, due to transmission, are eliminated before the determination of the weekly and monthly averages for publication in the Gazette, and the entry of the reduced observations in the volumes of records in which they are filed. In the case of the Imperial observatories this is done by means of Form B, supplied by the India Meteorological Office, and at the provincial or newly established observatories by means of postal cards. These are despatched daily by the first post after the time of observation.

The non-telegraphing provincial third class observatories forward their observations daily by means of post-cards. During the past year, they have, almost without exception, transmitted the observations regularly, and have thus enabled me to publish the weekly meteorological returns in a complete form.

The only station, the name of which appears in the weekly meteorological forms, but which fails to send in its observations in time, is Demagiri. This, however, is not an observatory maintained by Government, but a voluntary observatory, started in 1881 by the medical officer.

The rainfall observations at the 166 rainfall-recording stations are forwarded mainly by postal cards daily or weekly.

If rain falls during any day, the amount is entered in a postal card, Form C, and sent off by the first dâk leaving the station after the hour of observation (6 P.M.) for Calcutta. The returns of actual rainfall are, by this means, forwarded immediately after occurrence. As returns are occasionally lost, all stations are also required to send a weekly return on a postal card giving the amounts (nil or otherwise) of the rain on each day of the preceding week. This is useful as a check on the daily returns as received, and also as confirming the non-occurrence of rainfall during any week, which otherwise would be indicated only by the non-arrival of daily post-cards.

The number of postal card forms supplied to the observatories during the year was—

	Number.
Form G for meteorological observations	9,450
„ C for daily rainfall	50,662
„ D for weekly rainfall	12,994

A few stations are so situated that postal communication is very slow, and the returns for the last day of the week and the weekly return itself would invariably be received too late for inclusion in the weekly rainfall report. In these cases, special arrangements were made for the transmission of the weekly returns by dâk to the nearest telegraphic offices, from which they are telegraphed to Calcutta.

The rainfall stations which report weekly in this manner are—

Jamalpore.	Ruma.	Pooree.
False Point.	Sorah.	Cox's Bazar.
Saugor Island.	Jellasore.	Bhola.
Rangamati.	Jagatsingpore.	Palamow.
	Barripada.	

The arrangements are thus somewhat complex and required some time to effect. However, the great majority of the officers co-operated most heartily, and the changes were made on the whole with less trouble and much greater readiness than I expected.

Publication of Returns.—The frequent publication of meteorological statements giving the latest possible information was one of the most important features of the sanctioned extensions. This was carried out during the past year by the publication of—

1st.—The Bengal Weather Report from the 15th of May until the 6th November. When the extended system was fully established, telegrams giving the 10 A.M. observations were received daily from 31 stations in the province. These were reduced and tabulated as they arrived. The whole of each day's telegrams were received and the observations tabulated ready for the press by 3-30 P.M. daily. A brief summary was then written, describing in words the salient features and peculiarities of the weather of the previous 24 hours, and the whole sent off at 4 P.M. to the Bengal Secretariat Press, where it was printed in time for distribution to district officers by the mail of that evening. The work of distributing the report was done entirely by the Bengal Secretariat Press.

2nd.—A weekly meteorological and rainfall statement. The first part of this gives the average and extreme values of the elements of meteorological observations at all the observatories of the province for the week, and of the average district rainfall for the week, and its variation from the normal rainfall for the week. The second part gives the amount of the rainfall, day by day, for the preceding week, at each of the 166 sub-divisional and rainfall-recording stations, the total rainfall of the week, of the month up to date, and of the total rainfall from 15th May up to date, with corresponding normal or average amounts for comparison. A summary is added directing attention to the more important features of the meteorology for the week, more especially the distribution of rainfall. This return is published in the *Calcutta Gazette* every Wednesday morning, and gives the meteorological and rainfall observations for the week preceding the previous Friday evening.

3rd.—A monthly meteorological and rainfall statement, published usually during the second week of each month, and giving averages of the observations taken at the 44 observatories during the preceding month, a complete statement of the daily rainfall during the month at the 166 rainfall-recording or sub-divisional stations, and a summary giving the characteristics of the meteorology of the province during the previous month, and its more important points of difference from the normal weather of the period, and a brief analysis of the distribution of rainfall over the province during the month.

Preparation of daily averages.—The only other point which it appears necessary to describe was the method adopted to obtain the daily and weekly averages of the barometric height, maximum and minimum temperature, and rainfall required for the comparative statements and columns in the daily and weekly weather reports. The only averages hitherto obtained and used in the office were monthly averages. The reduced observations were recorded on large forms, each form containing the observations at a single station for a month, and the averages of these observations. This was a sufficient and satisfactory mode of preserving the observations, so long as all that was required was the preparation of monthly averages for the India Meteorological Office and for publication in the *Calcutta Gazette.*

The record of the observations in monthly sheets was on the other hand extremely inconvenient for the calculation of daily and weekly averages. It was hence found necessary to copy them into books specially prepared, so that the observations for the same day of the year might be found in the same column. These books thus contain a systematic record of the elements of observation to which they refer, and enable the average values of those elements of observation at any of the meteorological stations to be immediately determined for a day, week, or any other short period. The tabulation of the results in this way has also the further advantage of enabling the highest and

lowest values of the elements of observation at any meteorological station recorded since the establishment of the observatory at that station for any period of the year to be immediately ascertained.

Last year the 10 A.M. barometric readings, the maximum and minimum in shade temperatures, and the rainfall observations taken at the eighteen observatories that have been established for some years in the province, were copied from the monthly sheets into four large folio volumes, which will form the permanent record of these observations in future. If the strength of my office enable me to do it, I hope during the present year to have the humidity, cloud and wind amount tabulated in the same manner, when it will be possible to compare all the elements of observation (except wind direction) at 10 A.M. on any day of the year with the corresponding mean values for that day.

The rainfall observations at all the sub-divisional stations (160 in number) preserved in the office were also collected together and tabulated in the same manner, and the daily and weekly means obtained. These are the actual means and are employed for comparison in the weekly reports. The rainfall returns for each station will continue to be added, so that the twenty-four folio volumes which contain these observations will form the permanent record of the rainfall of the province.

Position of new observatories.—The following table giving the latitude, longitude, and elevation of the level of the mercury in the barometer cistern, so far as this has been ascertained at the additional observatories, is added :—

Latitudes, Longitudes, and Elevations of the Provincial Third Class Meteorological Observatories.

Meteorological Division.	Station.	Latitude.	Longitude.	Elevation in feet above mean sea level.	Level determined.	How determined.	Authority for elevation.
Orissa	Balasore	21° 30′ 12″	86° 58′ 16″	56·15	Barometer cistern at observatory.	Levelled to G. T. S. B. M. at False Point.	Executive Engineer.
South-West Bengal.	Midnapore	22° 15′ 33″	87° 21′ 45″	148·38	Barometer cistern at the Executive Engineer's Office.	Levelled to S. B. M.	Ditto ditto.
	Raniganje	25° 51′ 40″	87° 57′ 55″	?			
East Bengal	Noakholly	22° 48′	91° 0′	38·59	Barometer cistern on the 1st floor of the circuit-house.	Levelled to B. M. Chittagong Railway Survey.	Ditto ditto.
	Burrisaul	21° 41′ 40″	90° 24′ 30″	?			
	Serajgunge	24° 26′ 58″	89° 47′	?			
	Commillah	23° 28′	91° 14′	34·74	Ditto ditto	Ditto ditto	Ditto ditto.
	Furreedpore	23° 36′	89° 52′	?			
	Mymensingh	24° 45′ 13″	90° 27′ 21″	?			
North Bengal	Rampore Beauleah	24° 22′ 5″	88° 38′ 55″	71·97			
	Dinagepore	25° 38′	88° 40′ 46″	117·92	Barometer cistern	Levelled to G. T. S. B. M.	Assistant Engineer, Julpigoree Division.
	Rungpore	25° 44′ 55″	89° 17′ 40″	123·00	Ditto ditto	Ditto ditto	Ditto ditto.
	Julpigoree	26° 32′ 20″	88° 45′ 38″	283·70	Ditto ditto	Ditto ditto	Ditto ditto.
	Bhagulpore	26° 10′	83° 52′	160·18	Ditto ditto	Levelled to G. T. S. B. M. on Bhagulpore Church.	
Behar	Chupra	25° 46′ 42″	84° 46′ 49″	?	?		
	Motihari	26° 39′ 46″	84° 57′ 29″	223·6	Barometer cistern	By spirit levelling from G. T. S. B. M.	Sub-Overseer, P. W. Dept.
	Buxar	25° 34′ 24″	84° 0′ 46″	239·22			
	Arrah	25° 33′ 46″	84° 42′ 22″	192·82	Barometer cistern, Superintending Engineer's room.	Levelled to G. T. S. B. M. at Railway Station.	P. W. Dept.
	Dehree	24° 54′ 30″	84° 12′ 30″	351·14	Barometer cistern in dispensary.	Ditto ditto.	
Sonthal Pergunnahs and Chutia Nagpore.	Nya Doomka	24° 16′	87° 17′ 30″	?			
	Ranchi	23° 22′ 37″	85° 22′ 6″	2,128·14	Barometer cistern	Levelled to G. T. S. B. M. on the doorway of the Lutheran Church at Ranchi.	Overseer, P. W. Dept.
	Chyebassa	22° 32′ 50″	85° 50′ 57″	?			

Second class observatories.—These are, as last year, seven in number, of which five are in Bengal and two in Assam. The following table gives the superintendents and observers at these observatories during the year :—

Stations.	Superintendents.	Superintendent's allowance.	Observers.	Observer's allowance.	Assistant Observers.	Assistant Observer's allowance.
		Rs.		Rs.		Rs.
Sibsagar	Dr. R. M. Meiklejohn[1]	30	Baboo Dandadhor Dutt Barua.*	30	Baboo Ratneswar Gogoi.	10
	„ T. D. O'Partridge[2]					
Dhubri	Surgeon J. Mullane[3]	30	Munshi Monirud-din Ahmed.†	30	Kadimuddin[6]	10
	Assistant Surgeon Atul Chandra Rai.[4]				Baboo Andia Prosad De.[7]	
	Surgeon Edwin Dobson[5]					
Hazaribagh	„ R. Cobb	30	Baboo Nathoo Lal	30	Dwarkanath	10
Bankipore	„ T. G. French	30	Munshi Mohubbut Lal.	30	Mudden Mahunlal	10
Saugor Island	*Nil*	...	Mr. A. J. Moth[8]	45	.....	
			„ C. Williams[9]		.....	
			„ S. Holge[10]			
			„ J. A. Thomas[11]		*Nil.*	
			„ S. Holge[12]		.....	
			„ C. Williams[13]		.....	
			„ J. A. Thomas[14]		.....	
Cuttack	*Nil*	...	„ J. C. Smith[15]†	32	Mr. H. W. Alley*[16]	13
			„ H. W. Alley[17]		Mr. B. Sebastian[18]	
Chittagong	*Nil*	...	„ P. O. Pereira.	30	„ J. Dias[19]	15
					„ F. X. Derajo[20]	

[1] From 1st April to 6th September 1883.
[2] „ 7th September 1883 to 31st March 1884.
[3] „ 1st April to 18th August 1883.
[4] „ 19th August to 3rd November 1883.
[5] „ 4th November 1883 to 31st March 1884.
[6] „ 1st April to 6th October 1883.
[7] „ 7th October 1883 to 31st March 1884.
[8] „ 1st April to 1st June.
[9] „ 2nd June to 14th June 1883.
[10] „ 15th June to 14th August 1883.
[11] „ 15th August to 31st October 1883.
[12] „ 1st November to 24th November 1883.
[13] From 25th November to 30th November 1883.
[14] „ 1st December 1883 to 31st March 1884.
[15] „ 1st to 15th April and 20th July to 6th December 1883.
[16] „ 1st to 15th April and 20th July to 6th December 1883.
[17] „ 16th April to 19th July 1883 and 7th December 1883 to 31st March 1884.
[18] „ 16th April to 19th July 1883 and 7th December 1883 to 31st March 1884.
[19] „ 1st to 22nd April and 23rd July to 31st March (was on privilege leave).
[20] „ 23rd April to 22nd July 1883.

* Received special allowance of Rs. 5 per month for good services.
† Received special allowance of Rs. 10 per month for meritorious services.

Five of these observatories, *viz.*, Dhubri, Hazaribagh, Cuttack, Chittagong, and Saugor Island have self-registering anemographs. At the three first named stations the anemographs are of the Casella patern, which record the wind direction and amount at intervals of one hour. The remaining stations—Saugor Island and Chittagong—are provided with Beckley's anemographs, which

register wind direction and amount continuously. There were several breaks exceeding 24 hours in the working of these instruments, the dates of which are given in the following table:—

Stations.	Dates of commencement of work.	Periods during which instrument was out of order during 1883-84.
Dhubri	18th March 1882	From October 26th 8 A.M. to 27th 5 P.M.
Hazaribagh	15th April 1880	Nil.
Cuttack	11th April 1879	September 18th to 19th and December 16th to 18th.
Chittagong	20th June 1879	May 21st to 23rd, June 9th to 10th, July 11th to 13th.
Saugor Island	9th February 1880	May 21st to 23rd, October 25th to 27th.

Three of these observatories were visited during the cold weather, *viz.*, Dhubri, Sibsagar, and Bankipore.

Dhubri Observatory—Was inspected on the 14th and 15th of December 1883. No change of importance has been made in the position of the shed or the arrangement of the instruments since my last inspection in March 1882. The anemograph tower was erected shortly after that visit, and is situated on a fairly open site near to the thermometer shed. The tower is well built and in good repair. The barometer is kept in the lower room. The recording part of the anemograph is placed on a table in the upper room of the floor, which is by no means so steady and rigid as it ought to be for such an instrument. The observer is, however, very careful in looking after it, and has made one or two slight additions which not only show his interest in it, but which improve, to some extent, the working of the instrument. The anemograph and barometer were both found to be in very good order. The barometer was also cleaned in order to free it from the large amount of oxidized mercury which had formed in the cistern.

The thermometer shed was in good order. The instruments were clean and in very satisfactory condition. The observatory continues to maintain its high character, and is thoroughly satisfactory in character and accurate and valuable in its observations.

Sibsagar Observatory—Was inspected on 20th to 22nd December 1883 for the first time since its establishment in 1874. The station is situated at a distance of about nine miles to the south of the Brahmaputra in a flat open district. Much of the country between the station and the river is covered with cane jungle. To the south of the station, at a distance of over 20 miles, the Naga Hills rise up to a height of 2,000 to 6,500 feet and form a very marked feature. The Himalayas, the nearest snow peaks of which are at a distance of 70 miles, are also very distinctly visible in clear weather. The station itself is built on the banks of a very large square tank, about two miles in perimeter, the level of the water of which is about 20 feet above that of the adjacent country. The banks, supporting and containing this water, are very wide and large. The observatory is situated on ground formerly occupied by the civil jail on the eastern bank of the tank. The shed is unfortunately placed on the edge of the bank where it begins to slope down to a large shallow excavation, from which the earth was removed to form part of the bank, and is now filled with water. It is also shut in between two buildings (detached portions of the old jail), one of which is used by the observer as his residence, and the other as an office. This second or northern building contains the barometer. This instrument was placed in good light and was in good order, except that the surface of the mercury was oxidized. This was removed. The thermometers were tested and were all in good order. The shed was in fair condition. It was surrounded by a bamboo fence. The observer was requested to cut down several shrubs and high grass which interfered to some slight extent with the free circulation of the air in the shed. The anemometer and wind-vane are placed on the roof of the building containing the barometer, to which access is given by a strong iron ladder. They were in good order. The only defect was that the anemometer was screwed to the top of a long iron rod fixed on the roof, and hence oscillated to some extent with the motion of the air. The observer was instructed to have a small brick pillar built and the anemometer fastened to a shorter rod, the lower end of

which is to be buried in the brick pillar. The observer is very neat, careful, and accurate in his work, and the observatory in thoroughly good order. The observer deserves much credit for this, more especially as the station has hitherto been beyond the range of inspection by the Bengal Meteorological Office.

Bankipore—Was inspected on the 23rd of November 1883. No change has been made in the observatory since my last visit. It was found to be in the same satisfactory condition as last year.

Imperial Third Class Observatories.—These are 15 in number. Ten are situated in Bengal, one (Akyab) in Burmah, two (Silchar and in connection Tura) in Assam, and two (Gopalpore and Coconada) in Madras. The two last are maintained in connection with the Bay of Bengal Weather Service.

The following table records the superintendents and observers at these observatories during the year 1883-84 :—

Stations.	Superintendents.	Observers.	Observer's allowance.
			Rs.
Darjeeling, St. Paul's School.	R. Carter, Esq., Rector, St. Paul's School, Darjeeling	Mr. W. Moore	25
Purneah	Dr. Picachy	Baboo Rasick Lal Bose [1] „ Rajanikanta Chackervarti [2]	15
Durbhanga	„ W. A. Gilligan	„ Jogin Chunder Banerji. *	
Gya	„ R. McLeod [3] Baboo Benod Kishen Bose [4]	Lala Nowrungee Lal	15
Berhampore	Surgeon S. M. Shircore [5] Surgeon-Major F. C. Nicholson [6]	Baboo Mohendra Nath Roy †	15
Burdwan	„ H. B. Purvis [7] „ Cameron [8] „ R. D. Murray [9]	„ Mokhada Persad Chowdhry †.	15
Jessore	„ D. W. D. Commins [10] Asst. Surgeon Behary Lal Pal [11] Surgeon E. Bovill [12]	Baboo Poresh Nath Roy Chowdhry [13] „ Urjoon Mahanty [14]	15
Dacca	.....	Mr. J. S. David [15] „ T. W. DeSouza [16] Baboo P. C. Bose [17]	15

1 1st April to 31st May 1883 (transferred).
2 1st June 1883 to 31st March 1884.
3 1st April to 15th October 1883, and 23rd November to 31st March 1884.
4 16th October to 22nd November 1883.
5 1st April to 20th August and 21st November to 31st March 1884.
6 21st August to 20th November 1883.
7 1st April to 15th August 1883, and 1st to 14th January 1884.
8 7th August to 31st December 1883.
15th January to 31st March 1884.
10 1st April to 4th October, and 29th November to 31st March 1884.
11 5th October to 9th November 1883.
12 10th to 28th November 1883.
13 1st April 1883 to 6th February 1884, and from 20th February to 31st March 1884.
14 7th to 19th February 1884.
15 1st to 24th April 1883.
16 25th April to 21st December 1883, and 4th January to 31st March 1884.
17 22nd December 1883 to 3rd January 1884.

* Special allowances of Rs. 5 a month stopped for six months from January 1884 for neglect of duties.
† Received a special allowance of Rs. 10 a month for meritorious service.

Stations.	Superintendents.	Observers.	Observer's allowance.
			Rs.
Silchar	Dr. J. J. Monteith [18] „ A. H. Whitewell [19]	Baboo Romes Chandra Bhuddra	15
Demagiri	*Nil*	Asst. Surgeon Suryya Kumar Ghose	*Nil.*
False Point	*Nil*	Mr. E. Workman [20] „ J. London [21]	25
Akyab	*Nil*	„ H. J. Smythe „ R. J. Keys „ H. Vetriano	15
Tura	Civil Medical Officer	Civil Hospital Assistant	Voluntary station.
Gopalpore	Mr. A. L. Taylor, Port Officer	Mr. Goom Appala Narainhar	15
Coconada	Captain F. M. Gillham, Master Attendant	„ C. T. M. Gaetane	15

I was unable to inspect the majority of these observatories during the cold weather college vacation, which was fully occupied in visiting the Assam stations and the new or provincial third class observatories. Durbhunga, Gya, Darjeeling, and Jessore were visited by myself; Silchar by Mr. Blanford, Meteorological Reporter to the Government of India; and Dacca by my head clerk. The majority of these observatories are satisfactory in character, and the observations accurate and reliable. Two of them, I regret to state, although slightly improved, do not yet furnish observations upon which I am able to place implicit confidence. The observations sent in do not harmonize with those of the neighbouring stations, and the only possible inference I can form is that the discrepancies are due to carelessness or ignorance on the part of the observers. The observatories in question are those situated at Gya and Durbhunga. The only other explanation is that these stations possess very peculiar meteorological conditions, and that the discordance, the observations at these stations present, when compared with those of neighbouring stations, is due to a want of uniformity in nature, and not to defects in the observer or in his instruments. This solution of the discrepancy has been suggested in correspondence on the subject, but I am unable to accept it as the true solution, or to recommend it to Government as an explanation of the peculiarities in the observations at these stations.

Durbhunga Observatory—Was visited on the 25th of November 1883. The observer was absent from the station and had left his duties to be performed by a friend, without giving any intimation to the Meteorological Office. As specific orders had been given to the observer on a similar occasion (in November 1882) not to absent himself from his duties without giving the usual intimation to this office and obtaining the necessary sanction, the observer was called upon for an explanation. This was not satisfactory. The state of the observatory last year was disgraceful, and it was mainly in consequence of the observer's promise to be very careful in future, and to carry out the various regulations and orders with respect to the taking of observations diligently and exactly, that he was not deprived of his special allowance of Rs. 5 per mensem. As he has failed to comply with the clear and precise orders necessary to secure the continuity of accurate observation, I had no alternative but to recommend the Meteorological Reporter to the Government of India to withdraw his special allowance for a period of six months when he will be again permitted to draw it, if in the *interim* his observations are found to be satisfactory in character by comparison with those at neighbouring stations.

[18] 1st April to 3rd July and 9th October 1883 to 31st March 1884.
9th July to 8th October 1883.

[19] 1st April to 31st August, and 1st December 1883 to 31st March 1884.

[20] 1st September to 30th November 1883.

The shed was in good order and the thermometers fairly clean. The barometer was also satisfactory. The clock which was sent a few months previously was out of order, apparently due to carelessness on the part of some one, as there were signs of its having been dropped, or of its having fallen down. The wind-vane was excessively stiff, and had evidently not been oiled for months. I turned it round through an angle of 120°, and a small puff of wind which caused the anemometer to make 30 revolutions in a minute had no effect in moving it. The wind directions at Durbhunga for months past are hence, I fear, of little value. The anemometer was clean and in fair order. The observatory has improved since last year, but is by no means satisfactory; and I am unable from my continued experience of the observer's carelessness and neglect of orders to place confidence in his observations. If considerable improvement does not occur during the next year, I shall be compelled to call the attention of the Government of Bengal to the unsatisfactory character of the Durbhunga observatory.

Dacca Observatory.—My head clerk, who visited Dacca on his way to the new third class observatories in Eastern Bengal, reports as follows on the observatory at that station :—

The Dacca observatory was inspected on 13th February 1884. The barometer was in the same position as on the last inspection. The room has, however, been converted into a sitting room for the use of the Superintendent of Telegraphs of the Dacca Division, and he suggested that the barometer should be placed in another room. It was therefore decided to remove it to one of the office rooms where a suitable exposure will be provided for it. (This has since been done.)

The thermometers were in good order, but very dirty. The bulbs of the wet bulb thermometers were thickly covered with encrustation. The observer was instructed how to keep them clean for the future. The receiving bottle in the raingauge was found to be full of dust. There was a depth of at least a quarter of an inch of earthy matter collected at the bottom.

The anemometer and wind-vane worked well. They were clean and properly oiled.

The observer takes his readings accurately. The want of cleanliness in the thermometer shed is a fault which should be remedied. An observer who is interested in his work will always be careful to keep every instrument he uses as clean as possible compatible with the conditions of observation; and want of cleanliness is an almost unfailing evidence of carelessness and inaccuracy of observations.

Provincial Third Class Observatories.—These are the additional observatories established in accordance with the extended system sanctioned last year, and maintained from the Provincial Meteorological grant. They are 22 in number. The names of the superintendents and observers at these stations are given in the following table :—

Provincial Third Class Observatories.

Stations.	Name of Superintendents.	Name of Observer.	Observer's allowance.
			Rs.
Balasore . . .	J. H. Apjohn, Esq., Executive Engineer .	Baboo Radha Mohan Dass, Head Clerk	10
Midnapore . . .	Major A. D. McArthur . . .	Mr. Benjamin Augier . . .	10
Ranigunge . . .	.....	Baboo Sreeram Chunder Ghose, Civil Hospital Assistant.	10
Noakholly . . .	*Nil*	Baboo Benod Behary Paul, Supervisor, Public Works Department.	10
Burrisaul . . .	*Nil*	Baboo Hemcanto Deb, Overseer, Public Works Department, aided by Sub-Overseer.	10
Serajgunge . . .	*Nil* . . .	Baboo Heralal Seal, Telegraph Master	10
Commillah . . .	*Nil*	„ Nobin Chunder Biswas, Supervisor, Public Works Department, aided by Sub-Overseers.	10

Provincial Third Class Observatories—continued.

Stations.	Name of Superintendents.	Name of Overseer.	Overseer's allowance.
			Rs.
Furreedpore	*Nil*	Baboo Kadar Nauth Roy, Overseer, Public Works Department.	10
Mymensingh	Baboo Rakhaldas Chatterjee, Assistant Engineer.	Baboo Bamacharan Bose, Sub-Overseer	10
Rampore Beauleah	Executive Engineer	„ Gopal Chunder Chatterjee, Head Clerk.	10
Dinagepore	Executive Engineer, Julpigoree Division.	„ Behary Lal Banerjee, Overseer	10
Rungpore	Ditto ditto ditto	„ Dijobar Goopto	10
Julpigoree	Baboo Madhub Chunder Roy, Executive Engineer, Julpigoree Division.	„ Woomanath Moitro, Head Clerk	10
Bhagulpore	T. Beaty, Esq., Executive Engineer[1] D. F. Martin, Esq., Executive Engineer[2]	„ Jogut Chunder Bhadhary, Head Clerk.	10
Chupra	*Nil*	„ Kaliprosanna Moitra, Sub-Overseer.	10
Motihari	Baboo Durga Charan Chackravati, Assistant Engineer[3] Mr. J. Butler, Assistant Engineer[4] Mr. C. J. Clarke[5]	Baboo Rajendra Nauth Biswas, Sub-Overseer.	10
Buxar	Executive Engineer	Baboo Boycontonath Guho	10
Arrah	Executive Engineer	Mr. T. Webb	10
Dehree	Executive Engineer, Dehree Workshops	Baboo Tulsi Das Roy, Supervisor[6] „ Peary Lal Sen, Assistant Surgeon[7]. „ Poorno Chunder Purkait[8]	10
Nya Doomka	Dr. R. A. Barker, Civil Surgeon, Sonthal Pergunnahs.	„ Dwarkanath Mookerjee	10
Ranchee	*Nil*	„ Peary Mohun Banerjee, Overseer	10
Chyebassa	The Head Master, Zillah School	„ Motilal Sarkar, 3rd teacher, Zilla School.	10

As the orders of the Government of India sanctioning the proposals of the Government of Bengal for the extension of meteorological work in Bengal were not received until the middle of March (Revenue and Agricultural Department No. 17 Meteo., dated 13th March 1883), it was not possible to arrange that the sheds should be built and the work of observation commenced by the date originally proposed, *viz.*, 1st April 1883.

My college duties prevented my visiting the various stations to select the sites for the observatories; it was therefore necessary to leave this to the judgment of the Public Works officers. Instructions were communicated to them, and in the great majority of cases excellent sites were chosen. In some few instances difficulties of various kinds prevented the utilization of the most suitable site

[1] From 4th June to 22nd July 1883.
[2] „ 23rd July to 31st March 1884.
[3] „ 30th May to 3rd December 1883.
[4] „ 1st January to 8th February 1884.
[5] „ 9th February to 31st March 1884.
[6] From 1st April to 14th May 1883.
[7] „ 15th May to 28th November and 10th February to 31st March 1884.
[8] „ 29th November to 9th February 1884 (Baboo P. L. Sen on leave).

selected by the Public Works officers. In these cases sites more or less inconveniently situated and badly exposed were necessarily chosen. The observatories erected on these sites will, as the value of the extended meteorological system is recognised, I feel confident, be permitted to be removed to more suitable positions than they at present occupy.

I deemed it advisable to spend a considerable part of the college vacation in visiting these observatories to ascertain the condition of exposure of the instruments and to remedy any defects that might have arisen in the construction of the sheds, arrangement of the instruments and the methods of observation. The sites, it should be remembered, were selected by Public Works officers in accordance with instructions issued from this office, and the work of observation carried on by Overseers or Sub-Overseers of the Public Works Department who had received no previous training, and merely carrying out as they best could (frequently with the assistance of the Assistant Engineers or Executive Engineers) the methods and instructions as described in the *Vade Mecum*. The results, as will be seen from the following reports on the stations visited, were very much more satisfactory than I expected. A few defects were observed, but in the great majority of cases the work of observation was performed quite as satisfactorily and accurately as at the third class stations. The reports are given in the order of place and not in the order of time of inspection.

Ranigunge Observatory—Was inspected twice during the year. The observatory is attached to the subsidiary jail, the hospital assistant who is in charge of the jail taking the observations. The shed is erected in a large open space enclosed by the jail walls, and is constructed in accordance with the standard plan. The walls enclosing this compound are from 6 to 10 feet high, and are at distances varying from 20 to 60 yards from the shed. The instruments were in good order. The raingauge is placed in the open near the observatory shed, at a distance of about 10 yards.

The barometer is kept in the office room, and is in good light.

The wind-vane and anemometer are placed on the roof of the office room, and are well exposed, as they are on the highest part of the jail buildings, which are on the highest ground in the station, and at a considerable distance from large trees.

The observer had some difficulty in learning to read the barometer and anemometer correctly. He was not able to procure any assistance in Ranigunge, nor was he able to leave his post to come to Calcutta for a course of instruction at the Alipore observatory. Hence my two visits were chiefly spent in teaching him to read these instruments correctly.

The observer appears to be careful in his work and willing to do his best. The observations have been during the latter part of the year fairly satisfactory and trustworthy.

Noakholly Observatory.—The Noakholly observatory was inspected by my head clerk on the 6th February 1884. The shed is in the circuit-house compound, and is generally built in accordance with the standard plan. The eaves were found to be 2½ feet higher than they ought to have been. The instruments were in good order. The anemometer worked very heavily. On examination it was found to be defective. The teeth of the cog-wheels were worn away. The instrument was returned to Calcutta and replaced by another.

The observations at Noakholly have hitherto been taken by the Overseer, who is frequently obliged to leave the station on duty; there have hence been frequent breaks in the observations. The Magistrate suggests certain changes, which will, if carried out, secure continuous observations. He proposes that the shed be removed to the jail compound (in which there is a very large open space where it would be conveniently placed) and that the anemometer and wind-vane be placed on the roof of the collectorate and the barometer in one of the rooms of the Collector's cutcherry (*viz.*, the Collector's waiting-room). If this were done, the civil hospital assistant, who is in charge of the jail dispensary, would be able to take the observations, and as he is very intelligent and lives in quarters in the jail, his appointment as observer would secure regular and continuous, and in the opinion of the Magistrate, accurate and trustworthy observation. The changes suggested by the Magistrate will therefore, if possible, be carried out.

Burrisaul Observatory—Was inspected by my head clerk on the 31st January and 1st February 1884. The observatory is situated at a distance of about one and a half miles from the circuit-

house bungalow and close to the Burrisaul river. To the south of the observatory shed, at a distance of about 250 feet, is the depôt for the night-soil of the district jail prisoners (numbering 500). The site is objectionable on this and other accounts. The ground is low. The site is near the river, and during the rains, when it is full, the water overflows and reaches within 50 or 60 feet from the shed. There is also a large tope of mango and other trees at a short distance to the south-west. The site is open in other directions. The barometer is, however, kept in the Public Works Department inspection bungalow, at a distance of one and a half miles from the shed, and a single set of observations hence requires two observers, one to read the barometer and the second the remaining instruments. The shed was originally erected in the circuit-house compound, but was removed by the orders of the Commissioner according to information received by the Inspector.

The Magistrate suggested its retransfer to its previous site, where it would be near to the room in which the barometer is kept, and also to the Public Works offices in which the observer is employed.

The instruments were found clean and in good order. The wind-vane and anemometer are placed on posts about 10 feet high. The barometer is kept in the Public Works Department inspection bungalow, and was found to be in good condition. The Public Works Department Overseer, who has taken the observations since the establishment of the observatory, takes much interest in his work and reads the instruments carefully and correctly.

Serajgunge Observatory—Was inspected by my head clerk on the 20th, 21st, and 22nd February 1884. It is situated in the grounds of the Telegraph Office close to the circuit-house bungalow. The district is low and flat. The soil is sandy and very porous, and dries rapidly after rain. In the rainy season the whole district is flooded.

The observing shed is well built, and is of the standard pattern, but of dimensions slightly different from those in the *Vade Mecum*. The whole structure stands on masonry work two feet eight inches from the ground. This was necessary as the ground is covered with water during the rains to a depth occasionally exceeding one foot and a half. The eaves of the shed being so high from the ground, the sun and rain strike inside the shed. The cage was found to be shaky. This has since been made right. The barometer is kept in the signal room of the Telegraph Office, which is a thatched shed. There is no pucca Government building near the Telegraph Office where the barometer can be placed. The instrument is in good order.

The cage instruments are in good order, excepting the wet thermometer, the bulb of which was partially covered with encrustation. This was owing to the use of well water for the reservoir. The observer was cautioned against the use of any water except rain and distilled water, and in their absence well boiled water.

The raingauge requires to be embedded in masonry work at least one foot high to protect it from being flooded over during the rains. The observer did not know that he had to use the receiving bottle for the gauge. It was kept aside in a godown. His attention was drawn to the chapter in the *Vade Mecum* on "Raingauge."

The wind-vane and anemometer are placed on the roof of the sub-collectorate, a one-storied building about 15 feet high. The instruments are reached by a strong ladder, and are at present fixed on two small blocks of wood on the parapet of the roof; but they are likely to be blown down. The observer has therefore been asked to submit an estimate of the cost of erecting masonry pillars on which to place the instruments as directed in the *Vade Mecum*. It is proposed to erect a block of two-storied buildings for the collectorate, and when they are completed the wind-vane and anemometer might be removed to the top of the new building, which will give a good exposure for the instruments.

The level of the barometer has not yet been determined for want of a datum level, the nearest bench-mark being several miles off from the station.

The observer takes much interest in his work, and records his observations very accurately.

Commillah Observatory—Was inspected by my head clerk on the 9th February 1884. The station is situated on level ground. Throughout the district are scattered numerous large tanks.

To the north-east rise the Tipperah Hills, which are visible from Commillah in clear weather, and form a prominent feature in the landscape. The river Goomtee passes to the east of the station of Commillah at a distance of about half a mile, and to the west the Megna, a deep and very broad stream.

The barometer is kept in a room of the road cess buildings and is in good order. The thermometer shed is erected on the western edge of a large tank, at a distance of about 10 feet from the edge of the water. It is well built and in good order. Except on the side towards the tank, it is surrounded by a fence at a distance of about 30 feet from the shed. The maximum thermometer was found to be out of order, and another was called for by telegram. The wind-vane and anemometer were originally placed on the roof of the collectorate, at a distance of about 150 feet from the room containing the barometer and 300 feet from the thermometer shed. The anemometer was returned to Calcutta as defective in August 1883. The roof of the collectorate is, however, not a very suitable place for the wind-vane, as it is a low one-storied building surrounded by tall trees, many double the height of the building. Hence the wind observations are not taken under satisfactory conditions, and it may be desirable to erect the wind-vane and anemometer on posts or pillars in the open ground near the thermometer shed.

The observations are taken by the supervisor and two sub-overseers of the Public Works Department, and have been accurate and satisfactory in character from the commencement. The shed is neatly constructed and the instruments very clean and in capital order. The condition of the observatory generally reflects very great credit on the supervisor.

Mymensingh Observatory—Was inspected by my head clerk on the 25th, 26th, and 27th of February 1884. The town is situated on the west bank of the Brahmaputra river, which runs as a shallow broad stream (during winter) with high banks. The whole of the district is level and open, with the exception of the Muddapore jungle, which lies to the south-west, comprising an area of about 45 miles in length by 6 to 16 miles in breadth. This part is slightly elevated, averaging in height some 50 to 60 feet above the general level. The district is also intersected by many small rivers.

The observatory is situated in an open field close to the zillah and vernacular schools, the collectorate, and the Public Works Department offices. The shed is of the standard pattern and well built. The ventilating hole required to be replaced by a section of a bamboo as directed in the *Vade Mecum*. The site is open, but being near the play-grounds of the two schools, the instruments are subject to interference from the boys. There is a bamboo fencing round the shed, but it does not appear to be strong enough to keep off mischievous boys. It is desirable therefore to have a strong wooden fence round the shed with a small gate for entrance, which should remain closed against outsiders.

The barometer is kept in an office room of the Public Works Department, and well placed. The instrument is in good order. The height of the mercury in the cistern of the barometer above sea level has not been determined for want of a datum level. The observatory was without the hygrometers. They were reported to have been broken by some of the boys of the neighbouring schools. The maximum and minimum thermometers were properly exposed and were in good order. From a local investigation of the circumstances attending the breakage of the thermometers, the head clerk ascertained that the mischief was due to one Rajendro Kissore Roy of the 4th class of the Hardinge School, who was willing to pay for new instruments. The head master was asked to recover from the boy ₹20—the cost of the thermometers—and pay it into the treasury.

The wind-vane and anemometer are placed on two pillars on the top of the turret clock-tower in the collectorate, 52 feet high. The position is quite open and equal to that of the Alipore observatory. The rod of the wind-vane (Adie) was found to be slightly bent; this was (as reported) owing to the injury it had received during transit to Mymensingh. The instruments worked well and were found to be well oiled. The raingauge is well placed. The fence was a little too near. It has been removed further off.

The observer reads his instruments correctly. The Assistant Engineer takes great interest in the proper working of the observatory, and has trained the observer (a sub-overseer) well. The Public Works Department is providing a ladder to reach the top of the clock-tower.

Furreedpore Observatory—Was inspected by my head clerk on the 16th of February 1884. The shed is situated in the centre of a fairly large open maidan near the police lines, and at a short distance from the circuit-house.

It is well and strongly built, but, through some oversight, not exactly in accordance with the Bengal pattern. The chief defects were that there was no ventilating hole in the roof to permit the escape of heated air, and that the eaves were somewhat too high. These defects have since been remedied.

The thermometers were generally in very fair condition. The wet bulb was covered with a thickish encrustation in consequence of the use of tank water instead of rain water. The barometer is kept in a room in the jail building, and was found to be in good order. The raingauge is placed near the observer's home at a distance about half a mile from the shed, and was in good order. The wind-vane and anemometer were erected on a platform supported by posts with a bamboo ladder to reach them. The latter instrument was somewhat dirty. It was hence taken down and cleaned, and the observer instructed in the method of cleaning and oiling it.

The observer read the instruments correctly and takes much interest in his observations, which have been on the whole very satisfactory during the year.

The only defect in the observatory is that the instruments (barometer and raingauge) are situated at considerable distances from one another and the shed, and also from the house and office of the observer. My head clerk suggested the removal of the shed to a position in a field belonging to the municipality. I have, however, not thought it advisable to make any change at present, as the observations under the present system seem to be quite trustworthy and taken at the proper hour daily, and the removal of the observatory from one part of a station to another, to suit the convenience of the observer, would speedily do away with uniformity in the conditions of observation and registration.

Rampore Beauleah Observatory—Was inspected by my head clerk on the 10th and 11th January 1884. The observatory is situated near the Executive Engineer's office at about a mile and a half from the city. The river Ganges (Padma) flows as a deep wide stream to the south of the observatory at a distance of about 500 feet from the shed.

The barometer is kept in a room in the Executive Engineer's office. It was in a bad position as the light came directly from the front. The instrument has since been removed to a better and more secure position in the same room. The sea-level height has not been affected thereby.

The thermometer shed is of the standard pattern, but the air hole on the top of the shed instead of being a ventilating pipe was found to be of the form of an elliptical hole (about 2 feet by 1½ feet) permitting the sun's rays to enter at certain hours of the day, and affecting the thermometric readings. This has been remedied.

The thermometer cage instead of being set upon the southern pole in the shed had been fixed by means of two additional posts in the middle of the north and the south poles supporting the ridge. The observer was asked to set it in the proper place.

The thermometers were in good order with the exception of the wet bulb hygrometer. The bulb of this instrument was found to be completely coated with a thick deposit, and the muslin had evidently not been changed for some time, as it was very dirty. The muslin was removed. Instructions for keeping the instrument in order were also given to the observer.

The anemometer and wind-vane are placed on the terrace roof of the Executive Engineer's office, and appear to be in a satisfactory position. There are several high trees to the north and north-east of the building at a distance of about 100 or 150 feet from it, but they probably do not influence the wind direction to any appreciable extent. The anemometer was full of dirt and appeared to work with much friction. It was taken down, cleaned and oiled and reset in position, and the observer instructed to keep it clean in future.

The raingauge is in the garden compound of the Executive Engineer. The mouth of the funnel was not level. The funnel hole was completely choked up by dirt and earth. The rain receptacle was also far from being clean.

The observer read the instruments well.

Dinagepore Observatory—Inspected by my head clerk on the 8th January 1884. It is situated near the circuit-house in a fairly open space, but on low ground. The river Poonarvava flows to the west and north-west of the observatory at a distance of about one-fourth of a mile.

The barometer is placed in a brick-built store-room of the Public Works Department, and is in good light. The instrument was clean and in good working order. The shed is entirely of bamboo work, but strong and well thatched, and laid out according to the standard plan.

The thermometers are all properly exposed and in very good order. The anemometer and wind-vane are placed on the terrace of the Judge's court-house at a distance of about 725 feet from the thermometer shed. To the north and north-west of the building, at a distance of 100 to 140 feet, there are several large trees which overtop the instruments on the terrace. The instruments were in good order.

The raingauge is well placed, but the fencing was too near the instrument. The observer was instructed to remove it to a further distance, and this has since been done.

The observer is a subordinate of the Public Works Department. He appears to take great interest in his work, and reads the instruments correctly.

Rungpore Observatory.—The station of Rungpore is in the plains of Northern Bengal on low flat land between the rivers Teesta and Cosi. The observatory is erected on a large open maidan near the Collector's cutchery. The ground is somewhat low and apt to be flooded during heavy rains. The barometer is kept in an out-room of the Collector's court, and is conveniently situated in a good light.

The thermometer shed is situated about 100 feet to the north-west of the northern extremity of the Collector's cutchery. The post office is situated in about the same distance to the west; with the exception of these two buildings, the ground in the neighbourhood is very open and quite free from trees. The shed is very well built and was clean, and the instruments in satisfactory working order.

The anemometer and wind-vane are erected on the school-house—a building about one-fourth of a mile to the south of the observatory. The building is a lofty one, and the instruments are placed on small brick pillars, and are thoroughly well exposed. They are approached by substantial ladders.

The observatory is well built and the observations trustworthy. It reflects much credit on the Assistant Engineer who selected the site and superintended the erection of the observatory and the commencement of the work of observation.

Julpigoree Observatory—Inspected on the 6th January 1884. The observatory is situated on a large open maidan near the Executive Engineer's office and within a few minutes' walk from the railway station. The site is open, as the nearest trees and buildings are at a considerable distance. The river Teesta flows past the station at a distance of about half a mile to the east and north-east of the observatory. The banks of the river are low, and the district is alluvial.

In the absence of any brick building near the observatory, the barometer is kept in a thatched godown belonging to the Public Works Department walled by thick *durma* mats all round. It is in fair light and in good working order.

The shed is constructed of bamboo on the pattern laid down in the *Vade Mecum*. It is neatly and strongly built. The thermometers are in good order. The raingauge is well placed and free from any obstruction in all directions.

The anemometer and wind-vane are placed on a wooden platform 18 feet high, supported by poles with ladders to reach them. The vane is correctly set. The anemometer worked somewhat heavily and had evidently not been cleaned or oiled since its erection. It was taken down, cleaned, oiled, and reset in position, and the observer instructed how to keep it clean and in good working order. The head clerk of the Executive Engineer's office is the observer. He reads the thermometers correctly, but was doubtful and slow about the barometric and anemometric readings. Fortunately the Executive Engineer is much interested in the observatory, and frequently takes the barometric readings, so that the barometric observations hitherto taken have generally been satisfactory.

The observer was drilled for some time in reading the two instruments with fairly satisfactory results.

Bhaugulpore Observatory—Inspected on the 17th and 18th November 1883. The observatory is situated in the compound containing the dispensary and the Assistant Surgeon's quarters. It is on fairly open ground and well situated. The barometer is kept in a room of the dispensary, and is placed in a satisfactory light. The anemometer and wind-vane are both erected on the roof of the dispensary, and are reached by strong ladders. There are numerous trees in the neighbourhood, but they are at some distance away, and do not influence the readings of the wind-gauging instruments. The observatory is fairly good as to situation : the instruments well placed and in good order. The observer is also head clerk to the Executive Engineer, and is apparently both accurate and careful in his work.

Chupra Observatory—Was inspected on the 5th and 6th of December 1883. The station is situated on the northern bank of the Ganges, and is in the midst of a flat, well cultivated alluvial district. The observatory shed (well fenced in) is erected in the compound of the circuit-house bungalow, in one of the rooms of which the barometer is kept. The shed is neatly and strongly built in accordance with the Bengal pattern, and was found in very good order. The thermometers were all in good order, except the wet bulb, which, on examination, was found to be wrongly graduated. This defective instrument had apparently been issued without due examination by some oversight in both the Bengal and India offices. The readings of the wet bulb for the preceding months are hence entirely wrong, and the deduced humidity values of this station published in the Bengal daily weather reports during last year incorrect and misleading. A new wet bulb was sent very shortly afterwards to replace this defective instrument.

The wind-vane and anemometer are erected on the roof of the road cess offices. They are about 30 feet from the ground, and the neighbourhood is fairly open and free from large trees, so that the exposure is satisfactory.

The raingauge is kept in the compound of the same buildings. The distance between the circuit-house bungalow and the road cess offices is between one-fourth and half of a mile. This separation of the wind-recording instruments is not very satisfactory, but I was unable to propose any other arrangement, as it is very difficult to obtain a good exposure for wind-vane and anemometer in a mofussil station.

The instruments were all in good order, and the observer was accurate in his readings.

Motihari Observatory—Inspected on the 21st and 22nd November 1883. The station is in the Chumparun district, and is situated in a level alluvial district about 20 miles to the east of the river Gundack. The observatory is placed on a large maidan or open space between the new collectorate offices and the railway. There are no trees in the neighbourhood, as the new collectorate buildings have been erected at some little distance from the old station, and hence its exposure is much more open than in the case of the majority of our stations, and represents more closely the atmospheric conditions of the surrounding district than is usually the case. The shed is very substantially and neatly erected. It is enclosed at some distance by an open latticework which allows complete circulation of the air, but prevents admission to the cattle which pasture on the maidan. The thermometers were all clean and in good working order except the maximum in shade, which had apparently reached the observatory in a defective condition. (It was replaced by a correct instrument.) The barometer is kept in the Collector's waiting-room. The light is good, and the instrument in efficient working order. The anemometer is placed on one of the highest points of the collectorate buildings in capital position. The wind-vane has been for the present placed on the top of the central pole of the shed, and is reached by means of a ladder reclining on the roof of the shed. This is the only instrument that is not satisfactorily placed, and it would be very desirable to have the wind-vane placed on the top of the collectorate building in the position which I pointed out to the sub-overseer and observer. Strong ladders should be provided to enable the observer to mount to the roof of the collectorate with comfort and rapidity.

The observatory is in a very satisfactory state, and reflects much credit on the observer.

Buxar Observatory—Inspected on the 7th December 1883. The observatory at this station is in the fort. The interior of the fort is considerably elevated above the surrounding ground. At a

short distance to the north of the fort the Ganges flows past. The river here has the same character as at Benares. It flows as a deep stream between highish banks. The southern bank appears to be the higher at Buxar. There is no wide stretch of sand through which the river flows, as is the case in the lower reaches of the river. The only building in the fort is the office and residence of the Executive Engineer of the Buxar Canal. The barometer is kept in a room of the office and is in a very good light. The shed is erected in a small depression in the mud wall enclosing the fort, and is well exposed. The instruments were very clean and in good order. The wind-vane and anemometer are erected in one of the corner bastions, and are thoroughly well exposed and in perfect order. The observer reads the instruments carefully and correctly. The observatory is in very satisfactory order, and the observations of high value for accuracy.

Arrah Observatory.—Was inspected on the 4th and 5th December 1883. The observatory is in the compound of the office of the Superintending Engineer of the Sone Canals at a short distance from the railway station. The site is fairly open. The shed is strongly built, and is in very good order. The barometer is placed in a large office room and is in a capital light. The thermometers were all in good order, except the minimum in shade, the column of which had given some little trouble from its tendency to break. The observer was taught how to remedy this defect. The raingauge is in open ground near to the observatory. The wind-vane and anemometer are on the roof of the building, and are well exposed. The observatory is very satisfactory, and the observer accurate and careful in his work.

Dehree Observatory—Was inspected by my head clerk on the 22nd March 1883. It is situated in the Dehree Workshop dispensary compound. The shed is very old and shaky, and the thatching is thin and worn-out. The instruments in the cage were not set according to the approved standard regulations. They were correctly placed. There should be a fence round the shed. The barometer is placed in a room in the dispensary building, and was found in good order.

The thermometers were clean and in good order. The minimum thermometer was found to have some cotton stuffing inside the hole on the wooden board near the bulb. This has since been removed. The presence of the cotton stuffing quite close to the bulb may have slightly affected the minimum thermometer readings of the past months.

The anemometer and wind-vane are set up on the top of the dispensary bungalow. They are reached by a strong ladder and a flight of steps on the sloped roofing. The instrument is fixed to the upper end of a gas pipe five feet high, and is hence shaken by the slightest wind. The wind-vane (Adie) is placed close to and on a level with the cups of the anemometer, and is kept in continual motion by the rotation of the anemometer. As an effect of the shaking the pivot screw nut on the back of the dial wheels of the instrument had been thrown off from the worm of the screw and lost. The observer was asked to have the nut replaced from the workshops. Other instruments were found to be quite satisfactory.

Baboo Peary Lall Sen, Assistant Surgeon, is the observer. He reads the instruments fairly, and takes much interest in his meteorological duties.

Nya Doomka—Is situated in the Sonthal Pergunnahs at an elevation of about 500 feet in the midst of the broken country between the plains of Southern Behar and the Gangetic Delta. The station itself is situated on fairly level and open ground, but in its neighbourhood there are many low hills more or less wooded.

The observatory shed is in the compound of the dispensary. The shed was erected according to the pattern plan under the supervision of the Civil Surgeon, and is well built and in good order. The instruments were properly exposed and in satisfactory condition. The barometer is well placed in the office room of the Civil Surgeon.

The raingauge is placed at a short distance from the shed. The wind-vane was erected on the top of a pole about 16 feet high, and was read from below. The anemometer was not in position, as there is no proper building near the dispensary with a flat roof on which to erect the wind-vane and anemometer. I have since my visit sanctioned the erection of a brick pillar with a brick staircase for the accommodation of these instruments.

The observatory is in very satisfactory order, and the observer careful and accurate in his record of observations. The observatory is the only one as yet in operation in the large district known as the Sonthal Pergunnahs, and will, I trust, give observations of very considerable value. Its establishment was due to a suggestion from the Civil Surgeon, who has taken much interest in it, and made it one of the most efficient of those started last year under the new system.

Rainfall-recording stations.—There has been a slight increase in the number of rain-recording stations during the past year. In 1882-83 the number was 162, and in the official year 1883-84 it was 167. This increase is due to the establishment of the following rainfall stations :—

	Date of first sending in returns.
Naraingunge	June 1883.
Nowgong	July „
Siligoree	Do. „
Dehree	Do. „
Lohardugga	January 1884.

The returns from the great majority of these stations were received punctually and regularly. Delays occurred in the submission of the returns occasionally. The only stations which gave frequent trouble in this respect were Bagirhat (in Khoolna district) and Jagatsingpore (in the district of Cuttack). It was necessary on several occasions to call the attention of the sub-divisional officer in charge of the former station to the delay and inaccuracy in his rainfall reports.

Some of the rain-registering gauges for revenue purposes (*viz.*, at Commillah, Mymensingh, Rampore Beauleah, Burrisaul, Serajgunge) were examined by my head clerk on his visit from district to district during his inspection of the local observatories. He found in the case of every raingauge that he examined a large accumulation of dirt in the gauge and glass receiver; hence it appears to me probable that the raingauge and appendages are generally not kept as clean as they ought to be. Experience shows me that carelessness in not keeping instruments clean is frequently accompanied with carelessness of observation. I am of course not able to assert that such is the case in the rainfall-registration of Bengal. So far as I can judge from the examination of the rainfall returns, the registration of rainfall is effected with approximate accuracy, and the returns give generally consistent and continuous variations from district to district, which are the strongest proof of their correctness. In a few cases during the year they were evidently inconsistent, and probably wrong, due either to careless reading or neglect to measure the rainfall at the proper hour.

Instruments.—The following tables show the number of instruments that have been broken, or lost, or rendered unserviceable during the year 1883, at the Imperial and Provincial observatories, and of the instruments supplied to them during the year. The additional Provincial observatories, 22 in number, were finished with complete sets of instruments shortly after the commencement of the official year. These instruments were received almost without exception in good order, due mainly to the careful way in which they were packed by the Mathematical Instrument Department :—

Return of Instruments broken or otherwise injured at the Imperial Observatories in Bengal and Assam, 1883-84.

Stations.	Barometer.	Hygrometer.		Dry maximum.	Minimum thermometer.		Radiation thermometer.		Anemometer.	Wind-vane.	Raingauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Patna	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cuttack	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Chittagong	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
Saugor Island	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hazaribagh	...	...	...	...	...	...	...	...	(a) 1	...	...	...	...	...	...
Purneah	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...

(a) Worn out by prolonged use.

Return of Instruments broken or otherwise injured at the Imperial Observatories in Bengal and Assam, 1883-84—(continued.)

Stations.	Barometer.	Hygrometer.		Dry maximum.	Minimum thermometer.		Radiation thermometer.		Anemometer.	Wind-vane.	Raingauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Burdwan	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...
Berhampore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
St. Paul's School, Darjeeling	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Jessore	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
False Point	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dacca	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Durbhunga	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...
Gya	...	...	(a) 1	...	...	(a) 1	...	...	(a) 1	...	...	...	...	...	...
Akyab	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Gopalpore	...	...	...	...	...	...	...	...	(a) 1	...	...	...	...	...	...
Coconada	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sibsagar	...	...	...	1	...	...	...	1	...	...	(a) 1	...	...	...	...
Dhubri	...	...	...	...	...	...	...	(b) 1	...	...	...	...	...	...	...
Cachar	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tura	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Demagiri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

(a) Worn out by prolonged use. (b) Stolen.

Return of Instruments, &c., broken or otherwise injured at the Provincial stations in Bengal, 1883-84.

Stations.	Barometer.	Hygrometer.		Dry maximum.	Minimum thermometer.		Radiation thermometer.		Anemometer.	Wind-vane.	Raingauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Balasore	...	...	...	...	...	...	...	...	(c) 1	...	...	...	...	...	...
Midnapore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ranigunge	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Noakholly	...	...	...	...	...	...	...	...	(c) 1	...	...	...	...	...	...
Burrisaul	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Serajgunge	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Commillah	...	...	...	(e) 1	...	...	...	...	(e) 1	...	...	...	...	...	...
Furreedpore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mymensingh	...	(d) 1	(d) 1	...	...	...	...	...	...	...	...	...	...	...	..
Rampore Beauleah	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dinagepore	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...
Rungpore	...	...	...	...	(e) 1	...	...	...	...	...	...	...	...	...	...
Julpigoree	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bhaugulpore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

(c)—Defective.
(d)—Broken by a student of the Hardinge School, who paid for new instruments.
(e)—Out of order in transit.

Return of Instruments, &c., broken or otherwise injured at the Provincial stations in Bengal, 1883-84—(continued.)

Stations.	Barometer.	Hygrometer.		Dry maximum.	Minimum thermometer.		Radiation thermometer.		Anemometer.	Wind-vane.	Raingauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Chupra	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Motihari	(e) 1	...	...	(f) 1	...	...	...	...	...	...	...	...	...	...	...
Buxar	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Arrah	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dehree	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nya Doomka	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ranchee	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Chyebassa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

(*f*)—One condemned as defective. (*e*)—Out of order in transit.

* * * * *

Return of Instruments, &c., issued to start the Provincial observatories in Bengal during 1883-84.

Stations.	Barometer.	Hygrometer.		Dry Maximum.	Minimum thermometer.		Radiation thermometer.		Anemometer.	Wind-vane.	Raingauge.	Measure glass.	Lens.	Clock.	Sand glass.
		Dry.	Wet.		Dry.	Wet.	Solar.	Grass.							
Balasore	1	1	1	1	1	...	...	...	(a) 2	1	1	1	...	...	...
Midnapore	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Ranigunge	1	1	1	1	1	...	...	...	1	1	1	1	...	1	...
Noákholly	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Burrisaul	1	1	1	1	1	...	...	...	1	1	1	1	...	...	..
Serajgunge	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Commillah	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Furreedpore	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Mymensingh	1	3	2	1	1	...	...	...	1	1	1	1	...	...	...
Rampore Beauleáh	1	1	1	1	1	...	...	...	1	1	1	1	1	...	...
Dinagepore	1	1	1	1	1	...	...	...	1	1	1	1	1	1	...
Rungpore	1	1	1	1	(c) 2	...	...	...	1	1	1	1	...	...	...
Julpigoree	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Bhaugulpore	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Chupra	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Motihari	2	1	1	2	1	...	...	...	1	1	1	1	...	...	...
Buxar	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Arrah	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Dehree	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Nya Doomka	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Ranchee	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...
Chyebassa	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...

(*a*) To replace a defective instrument. (*c*) One out of order in transit.

The number of instruments destroyed by accident during the year was unusually small. The Chittagong, Purneah, Durbhunga, and Sibsagar observers each broke a thermometer during the course of the year whilst handling them at the time of taking the observations. No breakages have occurred during the year at the new stations. This is partly due to the fact that they are not provided with radiation thermometers which are the most liable to damage on account of the conditions of their exposure. It, however, indicates that the new observers have been very careful of their instruments, and it is exceedingly creditable to them.

A grass radiation thermometer was stolen at Dhubri. Efforts were made to discover the thief, but without success. Two thermometers, the wet and dry bulb thermometers, were broken at Mymensingh in the month of January. Suspicion fell on one of the boys of the vernacular school, and when my head clerk was in the station inspecting the observatory, he enquired carefully into the matter. The result was that the cost of the instrument was recovered from the guardians of the boy who broke the instruments and paid into the treasury.

* * * * * *

Central Office.—The office establishment on the 31st March 1884 consisted of the following clerks:—

Baboo Chandi Churn Chatterji, Head clerk.
„ Purna Chundra Mukerji, 2nd „
„ Bireswar Mukerji, 3rd „
„ Kamini Mohun Bose, Tabulator.
„ Joggeswar Roy, „
„ Debendra Nath Banerji, „
„ Rakhal Das Chuckerbutty, „
„ Ashutosh Roy Chowdhuri, „
„ Nibarun Chunder Chatterji, „
„ Joti Lal De, „
„ Nogendra Nath Paul, Draughtsman.

The amount of work which had to be done in connection with the extension of the system was much larger than I anticipated, and it was therefore necessary to employ temporary clerks for some months. Four were employed from 16th May to 15th July, and three from 16th July to 15th November.

The clerks generally have assisted zealously and intelligently in carrying out the extensions, and have worked very laboriously during the past year. Baboo Chandi Churn Chatterji has, as last year, been a most efficient head clerk. I desire also to place on record my recognition of the hard and useful work done by Baboos Kamini Mohun Bose and Debendra Nath Banerji, the former of whom was in charge of the rainfall registration and tabulation, and the latter of the preparation of the Bay of Bengal and Bengal Daily Weather Reports.

The following gives a brief summary of the work done by the office during the year:—

1. The correspondence which included 1,750 letters received and 2,440 letters issued, or 4,190 letters in all docketted and filed for reference. The following table will show the very large increase that has taken place in the office correspondence consequent on the extension and the rapid rate at which the correspondence has increased during the past two years:—

Year.	Letters received.	Letters issued.	Total number.
1879	621	579	1,200
1880	672	629	1,301
1881	601	635	1,236
1882	917	1,112	2,029
1883	1,750	2,440	4,190

2. The reduction and tabulation of the 10 A.M. and 4 P.M. observations taken at seven second class stations, and fifteen Imperial third class stations, and of the 10 A. M. observations taken at twenty-two Provincial third class stations, and also of the hourly observations taken on four days of each month at the following second class stations:—

Dhubri.	Patna.
Sibsagar.	Cuttack.
Hazaribagh.	Chittagong.

3. The entry of all the observations taken previous to the year 1883 at 18 stations in Bengal in books for reference, and in such a manner that the mean pressure, maximum or minimum temperature, and rainfall for any day of the year at any of these stations can be at once obtained. These are filed in four thick folio volumes, and the observations which continue to be taken are added, so that they form a continuous record of all the observations taken at each station, arranged in the simplest way for reference.

4. The entry of all the rainfall observations taken at the revenue stations filed in the office records into twenty-four large folio volumes in a similar manner to the preceding, so that the average rainfall for any day, or any week or month, or any other portion of a year, may be determined with the least possible labour.

5. The preparation of the Bengal daily weather report, from 15th May to 6th of November, and of the Bay of Bengal weather report during the year.

6. The preparation of the weekly and monthly meteorological and rainfall reports for the province published in the *Calcutta Gazette*.

7. The preparation of four sets of three rainfall charts monthly during the south-west monsoon period, 1883 (*i.e.*, from May to November), showing by colours—

(1) the average distribution of rainfall over the province for the month;

(2) the actual distribution of rainfall for the same month;

(3) the variation of the actual from the average rainfall, indicating whether it was in excess or defect, and the amount.

The four sets were all drawn and coloured by hand. One set was forwarded about the 8th of the succeeding month (to that to which it referred) to His Honour the Lieutenant-Governor; a second set to the Secretary to the Government of Bengal in the Revenue Department; a third to the Sanitary Commissioner; and the fourth was kept for office reference.

8. Preparation of special returns and a special set of charts, illustrating the distribution and partial failure of the rains in Bengal during the south-west monsoon period of 1883 (*i.e.*, from May 15th to November 15th). These were submitted to the Secretary to the Government of Bengal in the Revenue Department, and were referred to in the Resolution of the Government of Bengal in the Revenue Department, dated 18th December 1883, in the following terms:—"These results are shown upon charts which have been prepared by the Meteorological Reporter to this Government. The Lieutenant-Governor would have been glad had time permitted of these charts being lithographed and published with this Resolution; for an inspection of them, and a perusal of the correspondence published herewith, would have shown in a striking manner the intimate relation which exists between deficient rainfall and crop failure. In fact, it may be said that the information supplied to Government by the Meteorological Reporter suggests practically the same conclusions which an examination of the local reports dictates."

9. The preparation of tables giving the average and actual rainfall, and the difference between the actual and average rainfall (or variation) for each month of the year 1883 and for the whole year at 166 rainfall-recording stations. These returns were published in the *Calcutta Gazette* of the 30th January 1884.

Storm-signals.—No very severe cyclone was generated in the Bay of Bengal during the year 1883. A number of smaller cyclonic storms occurred during the prevalence of the south-west mon-

soon over the Bay. They gave rise to strong winds and stormy weather, and in one or two cases to winds of hurricane force over a small part of the Bay, more or less dangerous to any ships involved in them near the centre. The following is a list of all those which are known to have occasioned wind and sea, trying, if not dangerous, to shipping :—

1. Storm of June 13th to 16th at the commencement of the south-west monsoon, and which gave the first heavy burst of rainfall to Behar. It formed near the Balasore coast on the 13th, and advanced into Behar where it broke up on the 20th.

2. Storm of June 26th to July 4th. This was generated slowly near the Sandheads on the 26th and 27th, and was of considerable intensity, and remained nearly stationary until the 29th. It crossed the Balasore coast early on the morning of the 30th.

3. Storm of July 6th to 8th. This was formed at or near the Sandheads under similar conditions to the preceding, but was of small intensity. It crossed the Balasore coast on the afternoon of the 7th.

4. Storm of the 12th to 14th of July. This began to form on the morning of the 12th off the south Orissa coast, across which (between False Point and Gopalpore) the centre advanced on the evening of the 13th, or early on the morning of the 14th, into the Central Provinces. It was of slight intensity.

5. Storm of the 16th to 18th of August. This was formed in the north-west angle of the Bay and crossed the north Orissa coast near Balasore. This storm was very small, and of very slight intensity, and of no importance.

6. Storm of the 23rd to the 26th of August. This was generated further to the south than the preceding storm, and crossed the Ganjam coast between Gopalpore and Vizagapatam on the evening of the 25th. It was of slight intensity.

7. Storm of the 30th August to the 3rd of September. This depression crossed the coast near Balasore on the afternoon of the 2nd of September, and was of moderate intensity.

8. Storm of the 6th and 7th of September. This was formed immediately after the preceding, and followed along nearly the same track, crossing the Orissa coast to the south of Balasore on the morning of the 7th. It was of small intensity.

9. Storm of the 11th to the 15th of November. This was apparently generated in the Martaban Gulf, and advanced first in a north-westerly direction to latitude 16° N and longitude 93° 45′ E in the neighbourhood at Diamond Island, and then recurved slightly and moved northwards parallel to the coast and broke up in the neighbourhood of Akyab during the afternoon of the 14th. This was the most severe and intense storm of the year in the Bay, but was of very limited extent, and hence did not apparently affect the weather in the north-west angle of the Bay.

10. Storm of the 2nd to the 4th of December.

The above list of storms for the year 1883 presents two important peculiarities, which are both illustrations of generalizations and deductions, to which attention has been called in my cyclone reports. The first is the unusually large number of small cyclonic storms during the period when the south-west monsoon was in force at the head of the Bay and in Bengal. The south-west monsoon of last year was unusually weak, and terminated abruptly in the latter part of September. A weak monsoon is usually accompanied with heavier rainfall than usual near the head of the Bay, and with the consequent formation of a larger number of cyclonic storms or atmospheric whirls. The past south-west monsoon has apparently been a well marked illustration of this principle. The other important feature was the absence of storms during the period extending from the 15th of September to the 10th of November. After the abrupt termination of the south-west monsoon in Northern India, north-easterly winds set in almost immediately on the Coromandel Coast and gave heavy rain for several weeks, so that the commencement of the north-east monsoon in Madras last year was one of the most favourable for agricultural operations which that presidency has experienced for some years. Heavy continuous rain on the Madras coast during the October transitive period is, as indicated by the condensation theory of cyclones, unfavourable to the formation of cyclonic whirls on the Bay at that time. Experience confirms this, and indicates that a strong north-east monsoon on the Madras coast, with heavy and more or less continuous rain over the land, is associated with

an absence of cyclones in the Bay. The past year was a remarkable example of this principle. The October transition period was characterised by unusually fine weather in the Bay, and by the non-occurrence of a single storm until the 11th of November, when rainfall ceased for some time in the Madras Presidency.

Nine of these storms, *viz.*, Nos. 1, 3, 4, 5, 6, 7, 8, 9, and 10, although giving strong winds and a high sea at Saugor Island, did not appear to be of sufficient intensity to warrant the hoisting of storm signals. Warning signals were hoisted for storm No. 2 only.

On the approach of this storm, bad weather signal No. 6 was hoisted at 11-30 A.M. on the 28th June, intimating that a small cyclonic storm was formed near the head of the Bay. This was changed on the receipt of further telegraphic weather reports to signal No. 8, at 1 P.M. of the same day, intimating that the storm was advancing from the Bay to the coast on the west of the Hooghly, or between Saugor Island and False Point. The storm signals were taken down at 2 P.M. on the 30th.

Daily Weather Reports.—As stated in my last report, the form of the Bay of Bengal daily weather report was altered at the commencement of the official year. The size of the sheet was reduced, a better quality of paper was used, and a chart and form lithographed for it at the Lithographic Department of the Surveyor General's Office. The new form of report was first issued on the 15th May. The character of the report was not altered, but advantage was taken of the establishment of an observatory at Balasore to increase slightly the number of the stations sending observations for this report. The report now furnishes observations taken at 17 stations on or near the coast of the Bay, together with a summary of the more important features of the weather as indicated by the observations, and a chart giving the distribution of pressure, air motion, and rainfall. This report was supplied to 29 subscribers and 30 Government officials at the commencement of the year, and to 29 subscribers and 32 Government officials at the end of the year. The receipts from subscription during the year covered the cost of printing and distributing the reports. There was a small balance of Rs. 160-5-6 at the end of the year 1883-84, which was kept in hand in order to meet any repairs to the lithographic presses.

The Bengal daily weather report was first issued on the 15th of May. The first reports gave observations taken at 14 stations, with a short summary. The number of stations was gradually increased by the establishment of the additional observatories, and from the beginning of August daily weather telegrams were received from 31 observatories, including 4 in Orissa, 6 in South-West Bengal, 4 in East Bengal, 6 in North Bengal, 4 in North Behar, 6 in South Behar, and 1 in Chutia Nagpur.

These reports were published and issued by the Bengal Secretariat Press, and were supplied to 94 Government officials and to 3 subscribers.

Copies of the weekly and monthly meteorological and rainfall returns (as published in the Gazette) were struck off for the convenience of the public, and were supplied at a charge just sufficient to cover the actual expense of printing and distribution.

Marine Meteorology.—A fair amount of work has again been done in this Department. In consequence of the unusually heavy work thrown upon me during the past year in carrying out the extensions required for the Bengal Government, and of my absence for three months on privilege leave, I was not able to do as much as I desired. Mr. Dallas has continued to work steadily at the charting of the barometer and wind data of the Bay, and has finished this work up to the month of June. Two hundred and fifty-three sets of returns, giving meteorological extracts from logs, were sent in to me by the captains of vessels arriving in the port. The officers of several steamers belonging to lines trading between Calcutta and England take special observations in the Bay and Arabian Sea on their way home and back again. Log-books have been sent to me on several occasions with permission to make any extracts that were required.

The results of the working of the past two years has shown, it seems to me, conclusively that a large amount of valuable meteorological information can be easily obtained from the captains of vessels navigating the Bay, and that the majority of captains and officers of vessels, from the interest they take in the weather, are ready, even at considerable trouble to themselves, to fill in the returns in the hope they may be of some use in the investigations of the Meteorological Department.

Although the number of returns sent in is smaller than were received last year, they have been of higher quality. A fair proportion of the observations have been as accurate and carefully taken, judging from internal evidence and from a comparison with the land observations on the coasts of the Bay, as at our best land observatories.

I have utilized the information they have supplied in preparing an account of the two most severe storms in the Bay during the year 1883, *viz.*, that at the head of the Bay in the last week of June, and that off the Burma and Arakan coast in the second week of November. It is intended to publish this and the cyclone reports which were nearly finished last year, during the present year.

In addition to the information derived from the meteorological extracts from the logs of vessels, meteorological observations were taken at 10 A.M. and 4 P.M. on board the light vessels near the mouth of the Hooghly.

The following gives the names of the vessels at which observations were taken, and the period during which they were recorded :—

	Station.	Period.
Floating Light Vessel "Star"	Eastern Channel	April 1883 to 30th March 1884.
„ "Meteor"	Intermediate Station	April to 8th October 1883.
	Mutlah Station	November 1883 to March 1884.
„ "Foam"	Long Sand Station	September and October 1883, March 1884.
„ "Comet"	Upper Gasper	April to November 1883.
„ "Mermaid"	Lower Gasper	April to October 1883.
	Intermediate Station	February 1884.
„ "Planet"	Pilot Ridge Station	10th July to 19th September 1883.
	Intermediate Station	9th October to 30th November 1883.
	Upper Gasper	1st December 1883 to 31st January 1884.

Financial Statement.—The following gives the expenditure on account of the Bengal Meteorological Department during the year 1883-84, and the total grants sanctioned by Government under each of the various heads :—

Heads of Expenditure.		Actual expenses incurred during 1883-84.	Budget grant for 1883-84.
	Rs.	Rs. A. P.	Rs. A. P.
Meteorological Reporter's allowance	3,600	5,400 0 0	5,400 0 0
„ Marine	1,800		
Office establishment — Permanent		4,526 6 3	4,851 0 0
Office establishment — Temporary		400 15 5	400 15 5
Office rent		900 0 0	900 0 0
Observers — Telegraph Masters		2,100 0 0	9,240 0 0
Observers — Native Observers		4,440 0 0	
Observers — Provincial Observers		2,131 4 10	
Messengers' allowance		62 14 5	100 0 0
Allowance to Superintendents of observatories		1,440 0 0	1,440 0 0

Heads of Expenditure.	Actual Expenses incurred during 1883-84.	Budget Grant for 1883-84.
	Rs. A. P.	Rs. A. P.
Central Office.		
Contingent and office furniture	792 9 0	1,140 0 0
Postage	1,693 4 9	4,000 0 0
Telegraphic messages	12,199 4 0	19,000 0 0
Travelling allowances	1,423 7 0	1,780 0 0
Observatories.		
Building and repairs	1,093 3 6	2,550 0 0
Contingent	91 7 6	98 0 0
Total	38,694 12 8	50,899 15 5

The amount is Rs. 11,898-15-4 in excess of the actual expenditure of last year, but Rs. 12,205-2-9 less than the sanctioned grant. The savings have been mainly under the head of telegraphic messages, postage, and payments to provincial observers. The amount of the Bengal Provincial grant was calculated on the supposition that the new observatories would be in working order on the 1st April. Hence as the majority of them were not established until the middle of June or beginning of July, there was a considerable saving in the amount of payments to observers, and also under the head of telegraphic messages or weather telegrams. The transmission of observations by telegram and post under the extended system has also, in consequence of the ready co-operation of the various officials and the almost exclusive use of postal cards in place of the meteorological forms such as have hitherto been employed, been less expensive than I anticipated, and I have therefore proposed to Government that a portion of the Bengal Provincial grant, which would otherwise lapse yearly, be utilized to provide for certain additional observatories which are much needed to give additional information, and for a further increase of my office establishment.

There is apparently a large saving under the head "Building and repairs;" but this is, so far as I can ascertain, not real, but due to the fact that the cost of several of the new observatories has not been debited yet against the Meteorological Department by book transfer between it and the Public Works Department.

The figures in the statement give the total expenditure so far as can be at present ascertained by my office.

The statement does not include the cost of instruments supplied to the observatories by the Indian Meteorological Department, nor of the cost of stationery supplied to the Central Office, nor of the cost of printing the meteorological returns given in the Gazette or otherwise, or the forms required in the Meteorological office, by the Bengal Secretariat Press.

JOHN ELIOT, M.A., F.M.S.,
Meteorological Reporter to the Government of Bengal.

Meteorological Office, Bengal;
The 29th April 1884.

APPENDIX B.

Extracts from the Administration Report of the Meteorological Reporter to Government, North-Western Provinces and Oudh, for the year 1883-84.

The changes which have taken place during the year 1883-84 have been that the Reporter, Mr. S. A. Hill, took furlough from the 20th May 1883. At first Mr. Hill intended to have been absent one year only, but since he has been at home he has had the period extended by five months, and will not, therefore, rejoin his appointment till the 20th October. During Mr. Hill's absence I (Dr. Murray Thomson) have officiated as Reporter. The only other important change has been the abolition of the observatory at Paori, Garhwal. This observatory originated in the offer of the Missionary stationed there to take observations if instruments were supplied to him. After some time a small monthly allowance was paid to the observer; but, as there was no budget provision for the allowance, Mr. Hill very generously paid it out of his private funds, but it was discontinued when he left India. It was then found impossible to carry on the observatory without an allowance, and it was, therefore, resolved to remove the instruments, which was accordingly done. This is the less to be regretted as the Kumaon district has still two observatories—one at Ranikhet and one at Pithoragarh.

The following table shows the observatories which send records to this office and states how they are maintained. In the Appendix B II will be found a list of the Superintendents and the observers at these observatories:—

How maintained.	Class.		
	I.	II.	III.
By Meteorological Department	Allahabad (in abeyance).	Allahabad. Lucknow. Agra. Roorkee.	Chakrata. Ránikhet. Pithoragarh. Bareilly. Gorakhpur. Benares. Sutna. Jhánsi. Ajmere. Sambhar.
By other Government Departments.			Dehra.[1] Ghazipur.[2] Meerut.[4] Nowgong.[5]
Voluntarily by independent States, &c.	Jeypur.[3]		

1 Maintained by Survey Department.
2 Ditto Opium Agency.
3 Ditto State Darbar.
4 Maintained by Municipality.
5 Observer unpaid.

First Class Observatories.

The only observatory of this kind which is fully equipped is that at Jeypur. The preceding table shows that this is maintained by the Jeypur Darbar.

A special report on the working of this observatory during the past year has been furnished by its acting Superintendent, Surgeon C. W. Owen, C.I.E. Some extracts from this report will be given further on (Appendix B I). As has more than once been stated in these reports, it is intended to have a first class observatory at Allahabad, and the self-recording instruments intended for it have been lying unused in Calcutta for many months. All that is wanted is a suitable building in which to erect them. Sanction had been obtained to the greater part of the cost of this building, and a site had been fixed on, and a piece of suitable ground had been given, and the plans were prepared, when it was found necessary by the Government of the North-Western Provinces to withdraw sanction to the expenditure of the previously allotted money in favour of more urgent public works. This necessity is deeply to be regretted, as already the building of this observatory has been postponed from various causes for now over two years.

Allahabad is still worked as a second class station, and furnishes a very full set of observations. The observer has worked well during the past year, and the personal extra allowance of Rs. 10 per mensem is to be continued to him.

At present two of the instruments are, for want of a better site, exposed on the roof of the building now used as the Muir College, which is nearly a mile from the present main observatory. This is a very inconvenient arrangement, and I have requested sanction for the erection of a small tower, 30 feet high, near the present observatory, on which to place the instruments just mentioned and have them within easy reach.[1]

It was mentioned in last report that an experimental observatory had been set up in the grounds of the new Muir College in order to anticipate the effect on the observations by the removal of the instruments to a more open site. A table giving a comparison of the observations made at this new site with those made at the old was given in the last report, and a continuation of this table is given in this report.[2] As this experimental observatory has now served its purpose, observations at it have been discontinued since the 31st March of this year.

The underground temperature observations made with thermometers placed at half-an-inch, one foot, and three feet below the surface, have been continued during the past year.

* * * * * * *

Second-Class Observatories.

Lucknow.—There is very little to add to the remarks made on this observatory in the last report. A glass-case to protect the clock-work of the anemograph has been made. During an unofficial visit made to Lucknow in January last I went over the observatory and found all the instruments in good order; but a cover for the clock-work was much wanted, and I requested that one should be made for it. The observer here is an intelligent man, and has again rendered a good year's work: so he retains for another year the personal extra allowance of Rs. 10 a month.

Agra.—The only remark to be made on the observatory here is that the reading of the instruments is well and punctually done, but there is no improvement on the registers sent in. A good many corrections on errors in the computation have to be made. On account of this want of improvement I did not recommend the restoration of the full personal extra allowance. The observer will, therefore, for another year at least draw the minor allowance only.

Roorkee.—I inspected this observatory in October last and found all the instruments clean and in good order. The large Adie's barometer is still in use. A small portion of the inner surface of the tube has got fouled; several attempts to clear the tube have been made, but without success. Fortunately, the reading of the mercury level can still be made; and with accuracy, if care is taken. If this fouling of the tube increases, there is another compared barometer ready to take the place of the older one, so that there will be no discontinuity of the observations.

The observer here is a hard-working man, and is fairly neat and very punctual in his returns, and his computing work has greatly improved. * * * * *

Third Class Observatories.

Chakráta.—This station was inspected by me in October last. I found the instruments in good order and well situated, except the rain-gauge, the position of which I had altered so as to secure a freer exposure. At the time of my visit the observer, Salig Ram, stated that he was to be transferred to another Division of the Military Works (he is a draughtsman in the Office of the Executive Engineer of Military Works, and the latter is Superintendent of the observatory), but I am glad to be able to report that no change has been made. As this observer has worked well, his personal allowance of Rs. 5 has been continued for another year.

Meerut.—I visited this station in October last and found that all the instruments had been well cared for. The observer can be quite accurate in his reading of the instruments, but he is not always so. A bad instance of this occurred last December, when he sent in for the daily telegraphic report a

[1] Since the above paragraph was written Government has sanctioned the cost of this tower.
[2] Not reproduced here.—H. F. B.

series of wrong readings of the barometer: in them the error was found to depend on faulty adjustment of the fiducial point in the cistern of the instrument. When attention was called to this fault more correct readings were immediately rendered.

While visiting Chakráta, Roorkee, and Meerut, I also visited the observatory at Saint Fidelis' School in Mussooree. This station reports directly to the Reporter with the Government of India, and it was at the request of the latter that I made this inspection, for this observatory does not come under the supervision of the local Reporter. I was not at all pleased with the arrangements I saw. The instruments are well exposed, but they looked dirty and not over carefully attended to. A European youth of about 15 or 16 years of age was the observer. It was obvious he was not much impressed with the importance of being either accurate or punctual, although, I dare say, he would not intentionally send in erroneous work. Father MacCarthy, the Superintendent, put in a claim for a monthly allowance. I supported this claim, but with the proviso that, if given, it might be withdrawn at any time if careless work was rendered.

Other Observatories.

There are no remarks to be made on any other of the observatories. The work in them all, so far as can be judged from the returns sent, has been done with a fair amount of accuracy and punctuality.

* * * * * * * * *

Rainfall Registration.

The chief stations in all districts of the North-Western Provinces and Oudh are now supplid with rain-gauges of the Symon's pattern, but the subordinate stations still use the float and rod gauge.

The number of places which send in rain registers is 253. A separate annual report for the calendar year 1883, giving monthly and annual totals, was compiled in this office and published as a supplement to the Government Gazette of 29th March last.

A new edition of Mr. Hill's paper "On the Rainfall of the North-Western Provinces and Oudh" was published last year and was illustrated with a well-executed map.

* * * * * * * * *

Instruments.

Full details as to instruments issued to the various observatories are given in Appendix [1] and those broken in Appendix B III. * * * The number of breakages is very small, and is mostly confined to the exposed thermometers—sun and grass radiation. The anemometer entered for Agra as broken was really worn out and was no longer fit for use.

Statement of Expenditure.

This will be found in Appendix B V. The total expenditure is larger by Rs. 375 than in the previous year. This is accounted for by the entertainment of an additional clerk on Rs. 15 a month and the pay of all the clerks in the Reporter's office was increased by Rs. 5 a month for each clerk. The sanction of Government was obtained to the increase of expenditure for the purposes just mentioned.

Office and Office Work.

There is nothing to enter under this head, except that sanction was obtained from Government, as already mentioned, to the employment of an additional clerk on a salary of Rs. 15 a month. The establishment in the Reporter's office, as it now stands, is as follows:—

	Rs.
Chintamony Ghosh, head clerk	92
Kaliprosono Datta, 2nd „	55
Makhan Lal Mookerji, Tabulator	35
Ram Charan Pande, Ditto	25
Sasi Bhusan Banerji, Ditto	25
Ashutosh Bose, Ditto	15
One peon	6
One daftri	7
	260

No special work has been attempted this year, but the ordinary work has been well done.

[1] This is incorporated in the general return in Appendix K.

APPENDIX B I.

Extracts from Report on Observatory at Jeypur, by SURGEON C. W. OWEN, C.I.E.

"METEOROLOGICAL OBSERVATORY, JEYPUR.

Two new instruments have been added during the year, *viz.*, the Nephescope and the Sunshine Recorder.

The compound walls have been thoroughly repaired, the railings painted, the meteorograph tower re-coloured, new steps provided: in fact, the whole observatory has been thoroughly done up.

A great improvement has been effected in the meteorograph room by removing the battery to a separate room, where there is a more equable temperature.

Sheds have been built for the observers and new thatch has been placed on the guard and thermometer sheds.

All these repairs and improvements have been carried out without any extra expense to the Darbar.

List of Staff—

Durga Parshad	1st observer.
Nathu Narain	2nd ditto.
Hurbux	3rd ditto.
Hardeo	Peon.

Mr. Callaghan, the Electrician, has been of the greatest service during the year, and my best thanks are due to him for his ready assistance at all times. Daily weather telegrams have been despatched throughout the year to Simla and Calcutta.

Osler's anemograph.—This instrument, which forms a continuous register on metallic paper wrapped round the drum of the instrument, shows the direction, velocity, and force of the wind, and has been working nearly accurately throughout the whole year. The rainfall registered by this instrument during the year was 19·47 and the prevailing wind was north-west.

Nephescope.—This instrument is a new invention and consists simply of a glass mirror with the cardinal points marked on it and fitted with an iron pointer, so that the direction of movement of the upper-strata air can be noted by watching in which direction the clouds move from the fixed pointer.

This glass is placed on a marble column, on which the true magnetic North is marked. When exposed it distinctly reflects the whole sky; so that one can easily ascertain in what direction a particular cloud moves without the eyes being in the least dazzled by the intense light of the sun.

Sunshine recorder.—This instrument, which has lately been received, consists of a perfect globe of crystal, set in a stand and supported between two concave-surfaced screws, and is provided with a moveable arc, which requires adjustment according to the season of the year.

When exposed, a card of coloured paper with the gradations of hours marked on it from 6 A.M. to 6 P.M. is placed in the segment of the circle underneath the ball, and the rays of the sun are focussed on the middle of the scale, which chars the paper as long as the sun shines.

This charred line shows the hours during which the sun shone. It has been in use from the 1st of February 1884.

Meteorograph.—The working of this instrument during the year was on the whole satisfactory.

The instrument stopped on a few occasions, caused, firstly, by the warping of the wood fixed to the back of the cabinet, to which the different instruments are attached; secondly, the failure of battery power owing to imperfect porous pots procured in India and from England.

These imperfections have since been removed, first, by brass connections screwed to the detached pieces of wood; and secondly, by replacing the Daniel by a Menotti battery. This change was made on 1st November 1883, and it has worked very well since. It is presumed that this battery will last for another twelve months. The anemometer is the only portion of the instrument that gives trouble; the mechanism is so delicate that it frequently gets out of order, owing to the breakage of the delicate contact springs. These have been several times replaced and as often broken. We are now working it with light steel springs as a temporary arrangement until such a time as those indented for from Belgium arrive. Great difficulty was experienced in printing from the etched plates, owing to the want of a suitable press, and also owing to the etching not being sufficiently deep. A lithographic press is now in use adjusted to the pressure required, and the printing from this is as good as can be expected. We have begun to take very good impressions from 1st October 1883.

All the instruments that make up the meteorograph, except the anemometer, are in good working order, and the rainfall as registered by this instrument during the year 1883 was 20·85 inches.

APPENDIX B II.

Names of the Superintendents and of the Observers at the Meteorological Observatories in North-Western Provinces and Oudh during the year 1883-84.

Observatory.	Class.	Officer in charge.	Date. From	Date. To	Observers.	Date. From	Date. To
Allahabad	Second	S. A. Hill, Esq.	1st April, 1883	15th May, 1883	Kedar Nath Chaterji, Observer	1st April, 1883	31st March, 1884.
		Dr. Murray Thomson	16th May, 1883	31st March, 1884	Jadu Nath Chaterji, Observer at the new Observatory.	Ditto	23rd August, 1883.
					Bhola Nath Chaterji	24th August, 1883	31st March, 1884.
					Sasi Bhusan Banerji, Assistant Observer	1st April, 1883	Ditto.
Agra	Ditto	,, A. H. Hilson	1st April, 1883	Ditto	Mir Altaf Ali, Observer	Ditto	Ditto.
					Abdul Majid Khan, Assistant Observer	Ditto	Ditto.
Lucknow	Ditto	,, J. C. Whishaw	Ditto	5th February, 1884	Chotey Lal, Observer	Ditto	Ditto.
		,, J. Cameron	6th February, 1884	31st March, 1884	Durga Parshad, Assistant Observer	Ditto	Ditto.
Roorkee	Ditto	,, Murray Thomson	1st April, 1883	15th May, 1883	Cheranji Lal, Observer	Ditto	Ditto.
		Lieut. G. Onslow, R.E.	16th May, 1883	31st March, 1884	Tulsee Ram, Assistant Observer	Ditto	14th October, 1883.
					Jug Mohan Lal, Assistant Observer	15th October, 1883	31st March, 1884.
Jeypur	First	Surgeon-Major Hendley	1st April, 1883	22nd April, 1883	Durga Parshad, Observer	1st April, 1883	Ditto.
		Surgeon C. W. Owen, C.I.E.	23rd April, 1883	31st March, 1884	Nathu Narain, Observer	Ditto	Ditto.
					Hurbax, Observer	1st July, 1883	Ditto.
Chakrata	Third	Captain A. C. Ward	1st April, 1883	Ditto	Saligram	1st April, 1883	Ditto.
Paori	Ditto	Revd. J. T. McMahon	Ditto	30th Nov., 1883	Revd. F. W. Greenold	Ditto	30th Nov., 1883.
Pithoragarh	Ditto	,, Dr. R. Grey, and Revd. Buck	Ditto	31st March, 1884	Sher Singh	Ditto	31st March, 1884.
Ranikhet	Ditto	No Superintendent	.....	.....	Jewa Nund	Ditto	Ditto.
Dehra	Ditto	Deputy Supdt., Survey of India	1st April, 1883	31st March, 1884	The Head Computors	Ditto	Ditto.
Meerut	Ditto	Dr. W. Moir	Ditto	Ditto	Harsaran Das	Ditto	Ditto.
Bareilly	Ditto	E. A. Phillips	Ditto	Ditto	Jwala Parshad	Ditto	Ditto.
Gorakhpur	Ditto	Dr. C. Prentis	Ditto	Ditto	Nizam-ud-din	Ditto	Ditto.
Benares	Ditto	Principal, Benares College	Ditto	Ditto	Deokinandan Patak	Ditto	Ditto.
Ghazipur	Ditto	Dr. P. A. Weir	Ditto	Ditto	Babu Kunjan	Ditto	Ditto.
Sutna	Ditto	Agency Surgeon	Ditto	Ditto	Harnath	Ditto	Ditto.
Nowgong	Ditto	A. P. Mitchel, Esq.	Ditto	Ditto	.....	.....	.....
Sambhar	Ditto	W. Poneter, Esq.	Ditto	Ditto	J. Romare	1st April, 1883	31st March, 1884.
Jhansi	Ditto	Surgeon-Major Eades, Dr. Simmonds	Ditto	Ditto	Kalka Das	Ditto	Ditto.
Ajmere	Ditto	Dr. J. H. Newman	Ditto	Ditto	Ram Parshad	Ditto	Ditto.

APPENDIX B III.

Return of Instruments broken or otherwise injured at the Observatories in N.-W. Provinces and Oudh during the year 1883-84.

STATION.	Solar thermometer.	Maximum thermometer.	Grass thermometer.	Anemometer.	Solar thermometer stand.	Earth thermometer.	Wet bulb of hygrometer.	REMARKS.
Chakráta	1	...	...	...	...	...	...	
Ránikhet	...	1	...	...	...	...	...	
Agra	...	...	1	1	...	...	...	
Lucknow	1	...	...	...	1	...	...	
Allahabad new observatory	...	...	...	...	...	2	...	
Benares	...	...	1	...	...	...	...	
Sámbhar	1	...	...	...	...	...	2	
Ajmere	...	...	1	...	...	...	...	
Gázipur	...	...	1	...	...	...	...	

APPENDIX B IV.

Results of Underground Temperature Observations at Allahabad.

MONTH.	SURFACE.				ONE FOOT DEEP.				THREE FEET DEEP.				MEAN TEMPERATURE.			
	4 h.	10 h.	16 h.	22 h.	4 h.	10 h.	16 h.	22 h.	4 h.	10 h.	16 h.	22 h.	Air in shade.	Ground surface.	One foot deep.	Three feet deep.
April 1883 .	77·0	101·8	102·9	84·3	86·4	85·3	86·3	87·7	81·9	81·9	82·1	82·1	88·9	91·5	86·4	82·0
May „ .	83·2	106·9	106·5	89·8	92·8	91·8	92·6	93·8	88·0	88·0	88·1	88·0	94·1	96·6	92·8	88·0
June „ .	85·5	98·8	98·4	89·1	91·7	90·9	91·8	92·4	89·4	89·2	89·4	89·4	91·3	93·0	91·7	89·4
July „ .	83·3	88·3	90·5	85·5	87·4	86·8	87·0	87·6	87·4	87·3	87·4	87·3	84·8	86·9	87·2	87·4
August „ .	83·6	90·3	93·6	86·3	88·1	87·7	88·0	88·7	87·3	87·3	87·4	87·4	85·9	88·4	88·1	87·4
September „ .	81·5	90·1	91·3	87·2	86·9	86·4	86·8	87·4	87·1	87·0	87·1	87·1	83·1	87·5	86·9	87·1
October „ .	72·7	87·5	90·2	76·7	82·0	81·3	82·1	82·7	84·2	84·2	84·3	84·2	77·4	81·8	82·0	84·2
November „ .	60·7	75·4	82·0	65·8	73·0	72·5	73·2	73·8	78·0	77·9	78·2	78·0	66·0	71·0	73·1	78·0
December „ .	52·2	64·2	74·5	57·6	64·6	64·1	64·7	65·7	70·6	70·6	71·0	70·9	57·9	62·1	64·8	70·8
January 1884 .	55·0	65·8	77·3	60·7	65·7	65·0	65·5	66·8	69·0	69·0	69·4	69·3	61·0	64·7	65·8	69·2
February „ .	58·3	70·7	82·2	65·2	69·0	68·2	68·9	70·3	70·8	70·8	71·1	71·1	65·0	69·1	69·1	71·0
March „ .	71·0	90·9	97·7	78·1	80·1	79·3	80·0	81·6	77·8	77·9	78·1	78·1	80·1	84·4	80·2	78·0
Year .	72·0	85·9	90·6	77·2	80·6	79·9	80·6	81·5	81·0	80·9	81·1	81·1	77·9	81·4	80·7	81·0

APPENDIX B V.

Statement showing the expenditure of the North-Western Provinces Meteorological Department for the year 1882-83 (not including stationery, printing, or cost of instruments).

Station.	Imperial services.			
	Establishment.	Contingencies.	Reporter's travelling allowances.	Total.
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Meteorological Reporter	3,000 0 0	...	307 12 0	3,307 12 0
Ditto Office	3,105 14 0	†1,256 6 6	...	4,362 4 6
Allahabad Observatory	720 0 0	...	...	720 0 0
Ditto New observatory	*180 0 0	...	...	180 0 0
Agra Observatory	900 0 0	25 0 0	...	925 0 0
Roorkee ditto	900 0 0	14 15 0	...	914 15 0
Lucknow ditto	1,020 0 0	23 4 6	...	1,043 4 6
Chakráta ditto	240 0 0	...	...	240 0 0
Ránikhet ditto	300 0 0	...	...	300 0 0
Pithoragarh ditto	180 0 0	...	...	180 0 0
Bareilly ditto	180 0 0	...	...	180 0 0
Gorakhpur ditto	180 0 0	‡4 8 0	...	184 8 0
Benares ditto	240 0 0	...	...	240 0 0
Jhansi ditto	180 0 0	...	...	180 0 0
Total	11,325 14 0	1,324 2 0	307 12 0	12,957 12 0

* Temporary establishment for taking meteorological observations at the new observatory.

† Including office rent, charges for repairs to the observatories, and general contingencies of the Meteorological office and Allahabad observatory.

‡ Excluding charges for weather telegrams.

APPENDIX C.

Administration Report of the Meteorological Reporter to the Punjab Government for the year 1883-84.

The work of the Punjab Meteorological department in the past year has been carried on as usual. No change has been made in any of the observatories, which remain as follow:—

Lahore, Ludhiana, Simla, Delhi, Sirsa, Dera Ismail Khan, Multan, Sialkot, Rawalpindi, Murree, Peshawar, and *Leh* (*Ladakh*).

2. All of them, except Lahore and Leh, work as 3rd class; Leh and Lahore serve as 2nd class observatories. The position of the Lahore Observatory is faulty, but a better site is in contemplation by the Punjab Government, and the observatory will shortly be raised to a first class one.

3. As a second class station, Lahore registers 5 sets of daily observations, in addition to those registered here hourly, on 4 days in a month, *i.e.*, on 7th, 14th, 21st, and 28th of every month.

The observatory is under my daily supervision, in charge of Babu Jaspat Rai, the chief observer, and the condition of the observatory and good state of preservation of the instruments are due to the care of this observer.

4. The staff of the observatory, as in previous years, consists of an observer and assistant observer on a salary of Rs. 30 a month.

In addition to the routine work of the observatory, the observer in charge furnishes daily information of weather and climate to the *Civil and Military Gazette*.

INSPECTION.

5. During the year under report the observatories at Ludhiana, Simla, Delhi, and Sialkot were inspected and found to be in excellent order. The general character of the work of the observatories is very satisfactory.

I have little or no complaint against any of the observers. It was my intention to inspect all the observatories in the Punjab during the rains in the month of August, which is one of the vacation months at the Medical College; but last year the rain failed altogether in August and it was too hot to travel about in the plains; while in September I could not leave Lahore. The work of inspection is so important that I should like to make my chief observer, who is a reliable man, travel about inspecting the observatories at least twice every year.

6. All the observers selected for meritorious allowance during the year 1883-84 retained their allowance for the ensuing year. One of the observers, who was deprived of his meritorious allowance last year on account of laxity in his work, has been restored to the list of merit again, and will get Rs. 5, the increased allowance, in the ensuing year.

7. The office work is steadily increasing year by year, and on this account the engagement of a 3rd clerk was necessary during 1883. But, as we have taken in hand the computation of vapor tension and the making of duplicate copies, &c., which was done in the Head Office, Calcutta, heretofore, the addition of a new clerk has not given much relief to the existing pressure. The work is still in excess, and is too much for a small staff like ours.

8. The establishment of the Punjab Meteorological Office stands as follows :—

	Rs.	a.	p.
1 Head Clerk	50	0	0
1 Second Clerk	15	0	0
1 Third Clerk	15	0	0

9. During the year the Meteorological Office was removed from the Medical College, where it had been located since that building was opened, to new premises in the site of the old Dâk Bungalow. This arrangement is extremely inconvenient for the observers, who are also the office clerks, as the office is now nearly half a mile away from the observatory. I believe and hope that it is intended to increase the office establishment and raise the observatory to first class rank, and at the same time the present objectionable site of the observatory is to be abandoned and a new one is to be secured. In the new building the office will be attached to the observatory, and the work of both will be much facilitated.

10. The usual statements are herewith appended.

E. LAWRIE, M.B.,

Meteorological Repoter for Punjab Government.

LAHORE;

The 11th June 1884.

APPENDIX C II.

Table showing the Names of the Superintendents and Observers at the Meteorological Observatories in the Province of Punjab during the year 1883-84.

No.	Observatories.	Class.	Names of Superintendents.	Period. From	Period. To	Name of Observer.	Period. From	Period. To	Allowance. Monthly allowance.	Allowance. Meritorious allowance.
1	LAHORE	II	Ed. Lawrie, M.B., Meteorological Reporter, Punjab	Throughout		Jasput Rai, Chief Observer Dewan Chund, Assistant	Throughout		20 10	5 5
2	PESHAWAR	III	Surgeon W. Coates, M.D. „ M. O'Dwyer, M.B. „ T. E. L. Bate	1st April 1813 18th April „ 19th Feb. 1884	17th April 1883 18th Feb. 1884 31st Mar. „	Kashi Ram, Observer	Throughout		15	5
3	MURREE	III	Revd. G. C. Peake	Throughout		Mr. Cruickshank	Throughout		15	5
4	SIALKOT	III	Dr. Thomas S. Veele „ G. J. Shoud	1st April 1883 15th Oct. „	14th Oct. 1883 31st Mar. 1884	Futteh Singh, Assistant Surgeon Purma Nand „ Futteh Singh „ Sada Nand „	1st April 1883 6th July „ 14th Oct. „ 14th Dec. „	5th July 1883 13th Oct. „ 13th Dec. „ 31st Mar. 1884	15	
5	MULTAN	III	Surgeon-Major J. Bennett, M.D. „ P. R. Mulroney, M.D.	1st Mar. 1883 28th Mar. 1884	27th Mar. 1884 31st Mar. „	Mr. Wahid Alli	Throughout		15	
6	DERA ISMAIL KHAN	III	Surgeon P. de. H. Haig M. C. Cartin Surgeon-Major A. P. Holmes	1st April 1883 24th Oct. „ 10th Dec. „	23rd Oct. 1883 9th Dec. „ 31st Mar 1884	Nur Buksh Moshin Alli Nur Buksh	1st April 1883 22nd May „ 19th June „	21st May 1883 18th June „ 31st Mar. 1884	15	
7	SIRSA	III	R. Crossley, Civil Surgeon	Throughout		Shamsunder Lall Fazal Rahman	1st April „ 25th April „	24th April 1883 31st Mar. 1884	15	5
8	DELHI	III	Surgeon-Major G. C. Ross, Civil Surgeon.	Throughout the year		Asst.-Surgeon Ramkishen Pandit Bansi Dhur	1st April „ 24th July „	23rd July 1883 31st Mar. 1884	15	
9	SIMLA	III	Quartermaster General in India	Throughout		Sergeant J. J. Koings	28th May „	31st Mar. „	15	
10	LUDHIANA	III	Dr. Rouse, Civil Surgeon	Throughout		Asst. Surgeon Bhagwan Das Asst.-Surgeon Rallia Singh Asst.-Surgeon Bhagwan Das Asst.-Surgeon Sada Nand Asst.-Surgeon Bhagwan Das	1st April „ 11th May „ 18th July „ 1st Aug. „ 28th Oct. „	10th May 1883 17th July „ 28th July „ 27th Oct. „ 31st Mar. 1884	15	
11	RAWALPINDI	III	Dr. G. Massy „ T. R. Mulrony „ G. Massy	1st April 1883 15th April „ 15th June „	14th April 1883 14th June „ 30th Mar. 1884	Asst.-Surgeon Bhagwan Das	Throughout		15	

E. LAWRIE, M.B.,
Meteorological Reporter for the Govt. of Punjab.

APPENDIX D.

Extracts from the Administration Report of the Sanitary Commissioner, Central Provinces.

1. I only took charge in December 1883, and so inspected only the Seoni Observatory. I found it in good order.

2. The observatories remained the same as in 1882.

3. Nagpur.—Observer's conduct good.

4. Jubbulpore.—The Superintendent reports more favourably of the observer, but still is not sufficiently satisfied to recommend him for enhanced pay.

5. Pachmarhi.—The Superintendent was transferred to another station, so there is not any report on the observer's conduct.

6. Chanda.—The observer is well reported of. The Superintendent was changed thrice during the year.

7. Saugor.—The observer was most unfavourably reported of, and has, since the close of the year, absconded. The Superintendent was thrice changed.

8. Seoni.—The observer is, as on former occasions, well spoken of, and the Superintendent would be glad to see his pay increased.

A series of readings of a maximum and minimum thermometer, placed on an island in the middle of a large tank, were made during the whole year, for comparison with those taken in the observatory. The Superintendent summarises the observation thus :—

"It is thus shown that the minimum temperature was lower during the hot weather, owing to "evaporation : and higher in the other 3 quarters, owing to the water retaining the heat longer than "the land; these temperatures represent the condition at night.

"The day or maximum temperature was higher on the island in the cold months and lower in the hot months for similar reasons—retention of heat when there was little evaporation and absorption of heat from the air during evaporation.

"The island is about 800 yards from the observatory."

9. Hoshangabad.—There is nothing to note regarding this station, except that the conduct of the observer was good.

10. Khandwa.—A new barometer room was finished and the barometer moved into it on the 1st July. The meteorological shed was re-roofed and wire fencing placed round it. The observer is well reported of. The Superintendent was once changed during the year.

11. Raipur.—The barometer was moved during the year and the Superintendent reports its present position as "all that can be desired." The observer's conduct is well reported of.

12. Sambalpur.—A second shed was erected on the old parade ground, near the bomb-proof magazine, which is now the barometer-room; the anemometer and rain-gauge were also moved up to this site, which is open and free from trees and buildings. The old shed by the jail was repaired. The old instruments remain in the old shed and comparative observations have been taken since the 16th October last. In the new shed the following instruments were brought into use :—

Hygrometer, dry bulb ; hygrometer, wet bulb ; dry maximum thermometer ; dry minimum thermometer ; wet minimum thermometer ; grass radiation thermometer ; sun radiation thermometer ; rain-gauge ; and a barometer received on the 11th July was brought into use in the new room on the 16th October.

The Observer, Shamsoondur Dass, is well reported of. A second observer, Hospital Assistant Syed Mahomad Hydar Hussain Hydar, of the Jail Hospital, was entertained on the 16th October, and is said to observe regularly and correctly.

13. Sironcha.—The observer is well reported of. The Superintendent was once changed.

14. The usual statements are annexed.

JAMES H. LOCH, M.D.,
Offg. Deputy Surgeon-General and
Sanitary Commr., Central Provinces.

NAGPUR,
The 3rd May 1884.

APPENDIX D II.

Names of the Superintendents and Observers at the Meteorological Observatories in the Central Provinces during the year 1883-84.

Observatory.	Class.	Officer in Charge.	Date. From	Date. To	Observers.	Date. From	Date. To	Remarks.
Nagpur	Second	Surgeon-Major R. T. Wright, M.D.	1st April 1883	31st Mar. 1884	T. V. Allagheri Swamy	1st April 1883	31st Mar. 1884	
					Assistant Observer.			
					T. Soobiah	1st April ,,	31st Mar. ,,	
					Pandit Saduram Dubay	1st April ,,	31st Mar. ,,	
Jubbulpore	Ditto	Surgeon-Major W. R. Rice, M.D.	1st April ,,	31st Mar. ,,	*Assistant Observer.*			
					Hospital Assistant Kunji Behari Lal	1st April ,,	31st Mar. ,,	
					Madho Rao	1st April ,,	31st Jan. ,,	
					Kesho Rao	1st Feb. 1884	31st Mar. ,,	
Pachmarhi	Ditto	L. Gordon, Esq.	1st April ,,	31st Jan. ,,	*Assistant Observers.*			
		The appointment of Superintendent was vacant	1st Feb. 1884	31st Mar. ,,				
					Kesho Rao	1st April 1883	31st Jan. ,,	
					Luxmun Rao	1st Feb. 1884	31st Mar. ,,	
Saugor	Third	Surgeon-Major E. O. Tandy	1st April 1883	26th June 1883	Yado Rao	1st April 1883	6th Mar. ,,	
		Surgeon-Major J. W. Strong	27th June ,,	7th Dec. ,,	The appointment of observer was vacant	7th Mar. 1884	12th Mar. ,,	
Hoshangabad	Ditto	Surgeon-Major E. O. Tandy	8th Dec. ,,	31st Mar. 1884	Deevayal	13th Mar. ,,	31st Mar. ,,	
Khandwa	Ditto	Surgeon S. H. Browne, M.D.	1st April ,,	31st Mar. ,,	Jadunath Bose	1st April 1883	31st Mar. ,,	
		Surgeon-Major P. Cullen, M.D.	1st April ,,	16th July 1883				
		Surgeon-Major G. R. Dafthary, M.D.	17th July ,,	18th Oct. ,,	Bihari Lal Parasar	1st April ,,	31st Mar. ,,	
		Surgeon-Major P. Cullen M.D.	19th Oct. ,,	31st Mar. 1884				
Seoni	Ditto	Surgeon-Major J. B. Gaffney	1st April ,,	31st Mar. ,,	Punchum	1st April ,,	31st Mar. ,,	
Chanda	Ditto	Surgeon H. Armstrong	1st April ,,	14th April 1883				
		Appointment of Superintendent was vacant	13th April ,,	30th April ,,				
		Assistant Surgeon Haran Chunder Dutt	1st May ,,	31st Aug. ,,	Seetaram	1st April ,,	31st Mar. ,,	
		Assistant Surgeon Shib Chunder Bhattacharji	1st Sept. ,,	31st Mar. 1884				
Sironcha	Ditto	Assistant Surgeon Haran Chunder Dutt	1st April ,,	16th April 1883				
		Tehsildar Horahar Govind	17th April ,,	31st Mar. 1884	Hospital Assistant Muthu Krishna Naidu	1st April ,,	31st Mar. ,,	
Raipur	Ditto	Brigade-Surgeon D. W. Trimnell	1st April ,,	6th April 1883				
		Surgeon-Major J. F. Barter	7th April ,,	6th July ,,	Krishna Rao	1st April ,,	31st Mar. ,,	
		Brigade-Surgeon D. W. Trimnell	7th July ,,	31st Mar. 1884				
Sambalpur	Ditto	Honorary Surgeon-Major J. E. Harrison	1st April ,,	31st Mar. ,,	Babu Sham Sunder Dass	1st April ,,	31st Mar. ,,	
					Additional Observer.			
					Hospital Assistant Syed Mahamad Hyder Hussain Hydari	16th Oct. ,,	31st Mar. ,,	

APPENDIX E.

List showing the Names of the Superintendents and Observers at the Meteorological Observatories reporting immediately to the Office of the Meteorological Reporter to the Government of India during the year 1883-84.

Observatories.	Class.	Names of Superintendents.	Period. From	Period. To	Names of Observers.	Period. From	Period. To
Aden	Third	Captain C. W. H. Sealy	1st April 1883	29th Nov. 1883	D. C. Cotinho, Observer	1st April 1883	29th Aug. 1883.
		Major F. M. Hunter	30th Nov. ,,	31st Jan. 1884	A. S. Vas, ,,	30th Aug. ,,	18th Sept. ,,
		Captain C. W. H. Sealy	1st Feb. 1884	20th Feb. ,,	Shaik Ebrahim, ,,	19th Sept. ,,	15th Mar. 1884.
		Captain J. S. King	21st Feb. ,,	31st Mar. ,,	Walter Abraham, ,,	16th Mar. 1884	31st Mar. ,,
					Shaik Ebrahim, Asst. Observer	1st April 1883	18th Sept. 1883.
					A. S. Vas, ,, ,,	19th Sept. ,,	31st Dec. ,,
					B. C. Cordeiro, ,, ,,	1st Jan. 1884	31st Mar. 1884.
Bushire	Ditto	Licutenant-Colonel E. C. Ross, C.S.I.	1st April 1883	31st Mar. ,,	Mr. Azivedo	1st April 1883	31st Mar. ,,
Quetta	Ditto	J. C. Fullerton, M.B.	1st April ,,	31st Mar. ,,	A. Samuel Pillay	1st April ,,	31st Mar. ,,
Pachbudra	Ditto	Mr. G. A. Bradford	1st April ,,	31st Mar. ,,	Mr. P. Holder	1st April ,,	21st July 1883.
					Khudabux	22nd July ,,	12th Feb. 1884.
					Rash Behari Ghosh	13th Feb. 1884	31st Mar. ,,
Mussooree	Ditto	Revd. Father Lawrence	1st April ,,	31st Jan. ,,	J. Flynn	1st April 1883	15th Jan. ,,
		,, ,, Benedict	1st Feb. ,,	31st Mar. ,,	J. Archibald	16th Jan. 1884	31st Mar. ,,
Katmandu	Ditto	.....	.....	.....	Mohamad Hassain	1st April 1883	13th Aug. 1883.
					Pashupat Sharan Sinha	14th Aug. ,,	20th Oct. ,,
					Mohamad Hassain	21st Oct. ,,	28th Dec. ,,
					Pashupat Sharan Sinha	29th Dec. ,,	31st Mar. 1884.
Mongpoo	Fourth.	.....	.....	.....	George A. Gammie	1st April ,,	31st Mar. ,,
Makhla	Ditto	J. Balantine, Esq.	1st April 1883	27th Aug. 1883	Kuarsing	1st April ,,	31st Aug. 1883.
		A. T. Drysdale, Esq.	28th Aug. ,,	27th Nov. ,,	Narain Yadeo	1st Sept. ,,	18th Sept. ,,
		J. Ballantine, Esq.	28th Nov. ,,	31st Mar. 1884	Kuarsing	23rd Sept. ,,	19th Jan. 1884.
					Papannah	20th Jan. 1884	31st Mar. ,,
Diamond Island	Third	.....	.....	.....	F. W. Marsh	1st April 1883	31st Mar. ,,
Port Blair	Ditto	Surgeon-Major J. Reid, M.B.	1st April 1883	31st Mar. 1884	J. T. Peters	1st April ,,	31st Mar. ,,
Nancowry	Ditto	.....	.....	.....	Shaik Abdood Wahed	1st April ,,	12th July 1883.
					Shaik Madar	13th July ,,	24th Feb. 1884.
					Roop Sing Rana	25th Feb. 1884	31st Mar. ,,
Kailang	Ditto	Revd. A. W. Heyde	1st April 1883	31st Mar. 1884	Tsang Rinchen	1st April 1883	31st Mar. ,,

APPENDIX F.

Extracts from the Report on the Administration of the Meteorological Department in Western India during the year 1883-84.

During the past official year observations have been taken in Western India at 4 second class, 18 third class and 1 storm-warning station. No changes have been made in the nature of the observations; but it has been decided to institute a change in some of the observerships that will probably prove an important one. The same inconvenience which in last year's report it was stated had led to the substitution of civilian, in place of military, observers at the second class stations, has been felt in an equal degree in the case of those third class observatories at which military medical subordinates are observers. It has been determined, therefore, that, wherever practicable, these observers shall be replaced by independent men with whom the meteorological shall be the primary work.

Observatories.

The number of observatories, as shown by the list given in Appendix F II, remains the same as in last year. Sanction of the Government of India to the establishment of a voluntary observatory at Baroda was received through the Government of Bombay in September 1883, and accordingly instruments were forwarded to Baroda in November 1883. Mr. Joglekar, the headmaster of the Sirdar High School, who volunteered to establish the observatory, succeeded in getting an anemometer tower built over the porch of the school, and had chosen a site for the thermometer shed, when the school building was required for other purposes. The school had to be removed into temporary quarters, and the anemometer tower had to be pulled down. Mr. Joglekar hopes before long to be able to make other and more permanent arrangements.

For reasons given below under the heading of Inspection of observatories, the project for the establishment of an observatory at the new site at Sholapur has now been definitely abandoned, and after some difficulty arrangements have been made for the continuance of the observatory at the old site

On the 10th of October last, a letter was received from the Surgeon General with the Government of Bombay, stating that the Agency at Zanzibar was on the 1st of September transferred from the Government of Bombay to the English Foreign Office, and requesting that early arrangements might be made for relieving the Hospital Assistant there of his meteorological duties, as he was to be removed from Zanzibar immediately. This was the first intimation the Meteorological Office had of any intended changes at Zanzibar; had earlier information been received earlier arrangements might have been made for the continuance of the observatory there. As it was, the Surgeon General was pleased to agree to, and the Government of Bombay to sanction, the temporary retention as observer of the Hospital Assistant Abdur Rahman until the English Foreign Office could be moved in the matter. Up to the present date nothing has been communicated as to the intentions of the Foreign Office. Surgeon M. L. Bartholomeux, who had been the Agency Surgeon at Zanzibar, gave me, on his return to Bombay, a verbal description of the observatory there. This description agreed in all essential details with that given by Dr. Peters in his paper published in the Royal Meteorological Society's Journal for October 1883; therefore it is not necessary to reproduce it here.

Inspection of Observatories.

In October and December 1883; and in March and April 1884, I visited seventeen stations namely Bhuj, Karachi, Hyderabad (Sind), Jacobabad, Poona, Sholapur, Ratnagiri, Karwar, Calicut, Belgaum, Surat, Baroda, Deesa, Mount Abu, Neemuch, Indore, and Malegaon. Sholapur was visited twice; and with the concurrence of Miss Pogson, Meteorological Reporter to the Government of

Madras, I called, on the way to Calicut, to see the observatory at Mangalore, which is one of the stations forwarding daily weather telegrams to the Bombay Office.

* * * * * * *

SECOND CLASS OBSERVATORIES.

(*1*) *Karachi.*—The instruments here were in good condition and call for no special remark. A new site for the observatory had been chosen near to the anemometer tower; the position was better than the present one. Estimates amounting to Rs. 1,333 have been prepared for the buildings, &c., but, as it has not yet been decided to extend the hospital buildings, I have thought it advisable for the present to allow the matter to remain in abeyance.

(*2*) *Deesa.*—The instruments here were all in good order, except that the recording apparatus of the anemograph required cleaning, and the arrangement for disconnecting the clock and the cylinder were out of order. These matters I attended to. The trap door and the ladder of the anemograph tower were awkwardly constructed, and it was exceedingly difficult and even dangerous to use them. They are now about to be altered. The upper parts of the dry and wet bulb thermometers were screened by the frame-work of the cage door; so that, in order to read the higher degrees it was necessary to open the door. The observer pointed out that immediately after doing so the temperature within the cage went up about ·3 degree. I recommended him always to open the door before reading the thermometers.

The observer had great difficulty in getting an assistant. Deesa is nothing but a military camp, and is very backward in point of education.

(*3*) *Poona.*—The instruments here were in order, except that the grass thermometer pad had no stuffing. The observer had taken observations by Presidency local time instead of Poona local time; there is a difference of about 5 minutes. The Casella's anemograph had worked since last year with as satisfactory results as can be obtained from this class of instrument.

(*4*) *Belgaum.*—Everything on the whole was satisfactory at this observatory. The mercury in the barometer moved sluggishly, but the observer stated that he was in the habit of tapping it before reading. The observer, Ram Chandra Datta, had been trained by his predecessor; I examined him thoroughly, and found that he had taken pains to prepare himself for the examination. I instructed him in those matters in which he was deficient; cloud observation was his weak point, as indeed it is with many observers. I examined the assistant observer also.

Estimates for observatory buildings to be situated near the anemograph tower have been prepared amounting to Rs. 2,764; they have not yet been forwarded to Government for sanction.

THIRD CLASS OBSERVATORIES.

(*5*) *Jacobabad.*—The anemometer and the barometer were in good order. The graduation marks of the thermometers required re-blackening. The grass thermometer had been exposed under the stand of the sun thermometer by Narayen Mane, who had not understood that the sun thermometer stand, which is a moveable one, should have been taken away every night. The raingauge was placed on some bricks, and was in consequence about 3 inches too high. I had it properly fixed in the ground. Narayen Mane had been very ill for some time and quite unable to give proper attention to work of any kind. He was, at my suggestion, replaced in September by Bavaji Rawoot, whose work has given satisfaction.

(*6*) *Hyderabad* (*Sind*).—The instruments at the military hospital were all in good order; and the observer, V. E. Nazareth, who had trained himself in meteorological work by means of the instruction book, showed himself both careful and intelligent.

The same cannot be said for the observer who has charge of the anemometer at the jail. His work is so unsatisfactory in every way that his relief from meteorological duties only awaits the making of other arrangements for continuing the observations.

(*7*) *Bhuj.*—The surface of mercury in the cistern had been coated with a thin layer of rust, and three small particles of dirt had formed on the knife edge. The observer adjusted the mercury until it just touched these three particles; I approved of this method of adjustment, but the effect of it was,

of course, to lower the readings, the additional correction required was +·016. The barometer should be locked in a case or screen fixed to the wall; some of the hospital inmates came to finger it even in my presence. The thermometer shed was a little larger than the standard pattern, and the ventilating opening was too large. The thermometer graduation marks required re-blackening. The raingauge had, shortly before my arrival, been tarred all over, including the rim, so that the size of the rim was altered; but this I instructed should be cleaned off at once, and, as no rain had fallen in the meantime, the matter was of no consequence. The instruments in all other respects were in order. The anemometer post however was difficult to ascend; and in carrying the instrument up and down for cleaning, damage was likely to be done to the cups.

(*8*) *Surat.*—The instruments at the camp were found in order. Owing to the destructiveness of jackals, no grass thermometer has been supplied to this station since June 1883. An arrangement had been made by the observer for the protection of the grass thermometer, but it would have interfered with free radiation, and was therefore unsuitable. The wind direction observations of the observer, Dhunjibhai Motabhai had evidently been very roughly taken; and his punctuality was considered doubtful. He has since been ordered away to Quetta.

The observer who had charge of the anemometer at the castle was a new man, who had been instructed by his predecessor. He was intelligent, and easily understood what I taught him. The anemometer was out of order, the pointer being loose, and the spindle bearing the cups having become broken at the junction of the brass with the steel. I put the instrument in order and also instructed the observer in cleaning it.

Surgeon-Major Robb, M.D., F. R. Met. Soc. the Civil Surgeon, who, in accordance with his own wish, had charge of both the observatories, took great interest in the work, and, besides cordially assisting in the superintendence of the observatories, has forwarded to the metcorological office some special observations of his own.

(*9*) *Mount Abu.*—I found that, as previously surmised, the barometer No. 48-1868 by Adie had air in it; it was packed up and returned to Bombay. The old barometer No. 710-1868 was all right, except that the cistern was dirty inside. I showed the observer how by regulating the lights and shadows he could take very accurate readings with it. All the readings of the new barometer had better be rejected, and those of the old, which have been taken continuously side by side with the others, used in their place. The wet bulb thermometers had an incrustation of some thickness. The other instruments were in good order. The observer, Bapalal Metha, was trained by his predecessor, Corporal C. Barley, a year and a half ago. I pointed out to him all those parts of the instruction book which refer to third class observatories.

(*10*) *Neemuch.*—The barometer cistern was dirty inside, but it was quite possible to take correct readings. The fence round the radiation thermometers and raingauge was, I thought, too high; and the raingauge was protected by the sun thermometer stand. The wet bulbs of the thermometers were covered with sediment, but perhaps not more than was to be expected at Neemuch at that time of the year. The observer had covered them with lint instead of with muslin. The pointer of the anemometer was loose. The observer, T. Bachu, is a painstaking man, but he is very slow of understanding, and is scarcely able to discover for himself any irregularities that may occur in the instruments. He has recently become an attested military man, and is now liable to be removed for active service at any time.

(*11*) *Indore.*—The instruments were in good order, excepting that some of the thermometers required the graduation marks re-blackening. The anemometer was taken down and cleaned. The necessity for a tower for it is very great, as mentioned in last year's report, and I promised to make a sketch of what was required. The observer, Trimvakrao, who was trained by his predecessor, is an intelligent man, but for some reason or other his observations on two or three occasions have required very careful checking. I marked out for him those parts of the instruction book to which his attention was necessary, and tried to impress him with the importance of carefulness in his work

(*12*) *Malegaon.*—Solomon Aaron, who succeeded Gopal Cuddum, had left Malegaon a few days before my arrival there. His work was very defective. He was succeeded by an observer who had been trained at Poona, and who appeared likely to do the work satisfactorily. I examined him carefully and instructed him where he needed it. The barometer No. 27-1868, by Adie, had for some time been suspected to be out of order, as the readings at Malegaon for the past three or four years had been abnormally high when compared with the surrounding stations. But its vacuum was very good, and I could find nothing wrong with it except that the cistern was dirty, and that it was placed in a bad light. Dr. Carson had a new and well-lighted place provided for it, and by the proper regulation of the lights and shadows it was possible to read it in its new position quite accurately. I had taken with me a new barometer to be left in place of the old one, but on unpacking it air was found in the upper end of the tube, and it had to be returned to Bombay. I took to pieces and cleaned the anemometer (one of the five wheel ones); it had been very badly put together by some one, so that it not only worked stiffly, but the worm and worm wheel had become very much worn.

(*13*) *Ratnagiri.*—Everything was in good order here. The anemograph tower, however, requires additional protection from the rain, which during the monsoon makes its way through the laterite stone of which the tower is built, and causes the recording room to be very damp.

(*14*) *Sholapur.*—Application was made in the month of July last for sanction to be granted to the transfer of the observatory at this station from the old site to the telegraph office; but it was requested that before sanction was granted enquiries should be made as to the permanency of the telegraph office in its present quarters. Sanction was granted. The Telegraph Master was sent to Bombay for training, estimates for the necessary buildings were prepared and sanctioned by the Bombay Government, a set of instruments was forwarded to the telegraph office, the Telegraph Master began to take barometer and general weather observations, and he trained a man to take the observations for a year at the old site; but when the Public Works Officer came to the point of putting up the anemometer tower and other observatory erections, it was found that the permanency of the telegraph office in its present quarters was quite uncertain. This discovery upset all the arrangements; and it is only after much difficulty that the matter has been satisfactorily settled. A young man has been found willing to serve as observer at the old site on the pay of Rs. 15 with the prospect of good work allowances; he engages to live near to the observatory, and to remain there for some years. The observatory, therefore, will continue at the old site.

The man trained by the Telegraph Master, was, I found, unable to read the barometer correctly, and his readings from November 1st to December 20th have had to be rejected, and those of the Telegraph Master used in their place. The instruments were all in good order, except the wind vane, which had to be sent to Bombay for repair.

The height of the barometer cistern at the new site was 1566·70 feet above the sea-level.

(*15*) *Karwar.*—The instruments here were in good condition. Trees grew too close to the raingauge enclosure, and I recommended they should be cut down. The site is not good for wind observations owing to the surrounding hills, and for this reason the anemometer had never been erected, but Mr. Westbrook, the Port Officer and Superintendent of the observatory, said he would have it placed near the light-house, in the position which had once been occupied by an anemograph erected in connection with the tidal operations; wind observations will therefore be taken by the light-house keeper. The observer here, G. W. M. D'Aranjo, is a careful and intelligent man, and his observations are always trustworthy.

(*16*) *Calicut.*—This observatory was established by the Bombay Office in connection with the Bombay Storm Warning System, and is not a regular observatory; it has, however, all instruments except radiation thermometers, and the observer gets the usual monthly allowance. The thermometers I found were hung in the Port Officer's Office, a small second floor room with windows in the north, west, and south walls; the hygrometer was hung on the south wall, and the maximum, and minimum thermometers on the east. The raingauge was on the north-east side of the Custom House,

and I thought somewhat protected from the principal rain-bearing winds. It was fixed in a wooden frame-work, constructed after a local pattern. The anemometer was situated at the pier head in very good position; but it was fixed directly on to the ridge of a roof, contrary to express instructions, and was below the level of some neighbouring cranes. The entire re-arrangement of this observatory is under consideration; but there is difficulty in finding a suitable site.

* * * * * *

Work of the Second Class Observers.

The work of the observers appointed to Deesa and to Poona has given satisfaction, and that of the Karachi observer was on the whole good, except that I had reason to believe he left a great part of the observational work to his assistant. Keshav Vishnu at Belgaum soon gave evidence that he cared very little for meteorological work, and would be glad to get rid of it; after holding his appointment for only three months he applied to resign; his application was refused, but he applied again and again, and finally, after he had trained his assistant to do both the observational and the computing work, he sent word that he intended to leave the department, and would draw no more pay, though, if I would not grant his application, he would be obliged to attend the office up to the end of the time I had fixed. After some precautions had been taken for the proper carrying out of his work by the assistant, he was allowed to resign; his work was not of a very high character, and his successor, it will be seen from the list of merit, has given greater satisfaction. In January 1884 the Karachi observer applied to resign; arrangements were made for training his assistant, who has since relieved him.

Appointment of Independent Observers to Third Class Stations.

Great inconvenience has frequently been felt by the Meteorological Department in Western India in connection with those third class observatories at which the observers have been military medical subordinates. These observers have always been liable to frequent transfer in connection with their primary duties. It was seldom that notice of intended transfers reached the Meteorological Office, and it not unfrequently happened that men were appointed to these posts who were indifferently qualified for the work. In this way much extra correspondence has been entailed, and what is more serious, the character of the registers has sometimes suffered. I was induced, therefore, in January last to make certain proposals to the Surgeon General, Her Majesty's Forces, Bombay, with a view to preventing the breaks in the registers which resulted from these transfers, and to securing the appointment of only qualified observers. The ultimate result has been a decision to replace the military medical subordinates by independent men on the usual meteorological allowances whose primary work shall be the meteorological. This arrangement, if it be found workable, will be very satisfactory to the Meteorological Department, for not only will the character of the registers be improved, and (providing arrangements be made for relieving the observers during sickness) the interruptions be less frequent, but a great saving will be made in the work of the Bombay Office, as there will be less correspondence and less training of observers.

Alterations in the Factors of Instruments.

During my tours of inspection I compared the barometers and thermometers of all the observatories with the travelling standards; the results are given below—

Stations.	Barometer.	Dry bulb thermometer.	Wet bulb thermometer.	Dry maximum thermometer.	Dry minimum thermometer.	Wet minimum thermometer.	Grass radiation thermometer.
	Inch.	°	°	°	°	°	°
Kurrachee . .	Fallen ·011	Risen 0·3	Risen 0·2	Fallen 0·3	Fallen 0·1	Risen 0·1	.....
Deesa . . .	„ ·008	„ 0·3	Fallen 0·3	Risen 0·4	0·0	Fallen 0·4	.....
Poona . . .	„ ·005	„ 0·1	„ 0·0	„ 0·1	Fallen 0·1	„ 0·5	.....

Stations.	Barometer.	Dry bulb thermometer.	Wet bulb thermometer.	Dry maximum thermometer.	Dry minimum thermometer.	Wet minimum thermometer.	Grass radiation thermometer.
	Inch.	°	°	°	°	°	°
Belgaum . . .	Fallen ·009	Risen 0·1	Risen 0·1	Risen 0·3	Fallen 0·1	Risen 0·1	Risen 0·4
Jacobabad . .	·000	„ 0·2	Fallen 0·2	.....	Risen 0·1	Fallen 1·3	0·0
Hyderabad . .	Risen ·004	Fallen 0·1	Risen 0·2	Risen 0·2	„ 0·1	0·0	.....
Bhuj . . .	Fallen ·016	Risen 0·2	0·0	„ 0·2	„ 0·4	Fallen 0·3	Risen 0·1
Surat . . .	Risen ·001	0·0	Risen 0·2	„ 0·2	„ 0·1	„ 0·4	.....
Mount Abu . .	Fallen ·003	Risen 0·1	Fallen 0·5(?)	0·0	0·0	„ 0·1	Fallen 0·1
Neemuch . . .	Risen ·002	„ 0·2	Risen 0·2	0·0	0·0	„ 0·1	Risen 0·1
Indore . . .	Fallen ·005	0·0	„ 0·1	Risen 0·3	Fallen 0·2	„ 0·5	.....
Malegaon . .	Risen ·008	Risen 0·3	Fallen 0·2	„ 0·1	0·0	0 0	.....
Ratnagiri . .	Fallen ·003	„ 0·4	Risen 0·5	0·0	0·0	Fallen 0·3	0·0
Sholapur . . .	Risen ·002	„ 0·1	„ 0·2	0·0	Risen 0·2	„ 0·7	Risen 0·1
Karwar . . .	·000	„ 0·5	0·0	Risen 0·3	Fallen 0·1	„ 0·4	„ 0·1
Calicut . . .	Fallen ·004	„ 0·1	Fallen 0·1	„ 0·2	.....	.....	.....

In the table of alterations of factors given in the Administration Report of 1882-83, the words "Fallen" and "Risen" were interchanged throughout, and some other errors of computation were made. The following is the revised and corrected table for that year:—

Alterations of Factors of Instruments in 1882-83.

Stations.	Barometer.	Dry bulb thermometer.	Wet bulb thermometer.	Dry maximum thermometer.	Dry minimum thermometer.	Wet minimum thermometer.	Grass radiation thermometer.
	Inch.	°	°	°	°	°	°
Karachi . .	Fallen ·011	Risen 0·3	Risen 0·2	Risen 0·1	Fallen 0·2	Fallen 0·1	Risen 0·2
Deesa . . .	„ ·005	„ 0·2	Fallen 0·2	„ 0·5	„ 0·1	?	.....
Poona . . .	.....	„ 0·2	Risen 0·1	„ 0·1	„ 0·1	Fallen 0·5	.....
Belgaum . .	Fallen ·012	„ 0·2	„ 0·2	„ 0·4	0·0	.....	Risen 0·4
Jacobabad . .	„ ·002	„ 0·1	Fallen 0·2	.....	Risen 0·1	Fallen 0·8	„ 0·1
Hyderabad . .	Risen ·006	.....	.....	Risen 0·1	„ 0·4	Risen 0·1	0·0
Surat . . .	„ ·001	.....	Risen 0·3	„ 0·1	0·0	0·0	Fallen 0·3
Mount Abu . .	Fallen ·083 No. 48	0·0	„ 0·1	„ 0·1	Risen 0·1	0·0	0·0
Mount Abu . .	Fallen ·005 No. 710	.....	.....	.....	.....	.....	.....
Neemuch . .	„ ·004	Risen 0·1	Risen 0·1	Risen 0·1	.....	Fallen 0·3	.....
Indore . . .	„ ·006	„ 0·1	0·0	„ 0·4	Risen 0·1	„ 0·3	.....
Malegaon . .	Risen ·014	„ 0·1	0·0	0·0	„ 0·1	0·0	.....
Ratnagiri . .	Fallen ·004	„ 0·2	Risen 0·5	Risen 0·1	Fallen 0·2	Fallen 0·5	?
Rajkot . . .	„ ·008	„ 0·1	0·0	„ 0·3	Risen 0·1	„ 0·8	Risen 0·5
Amraoti . . .	.....	.....	.....	.....	Fallen 0·3	Risen 0·1	Fallen 0·4

The Library.

One hundred and eleven books were added to the library during the past year, making a total of 824. They have all been compared with the catalogue and found correct.

Work of the Bombay Office.

The work of the office has consisted of the usual receipt, correction, computation, and tabulation of the observations from the third class observatories, and the correction and tabulation of those from the second class observatories; the checking of these observations by means of actual and abnormal curves, and the examination of every discovered instance of erroneous or doubtful observation; the training and in some cases appointment of observers; the comparison and issue of instruments; the conducting of the storm-warning service; the receipt, arrangement, and in some cases translation from the vernaculars (but not the control) of rainfall returns from over 400 stations; the forwarding of the complete monthly returns to the Meteorological Reporter to the Government of India, and of the monthly abstracts published in the *Bombay Government Gazette;* the furnishing of special information to the public and to Government departments; the conducting of special investigations and research; the management of the finances of the department; and the conducting of the correspondence involved by all the above-mentioned works.

Training of Observers.

The following is the list of observers trained in the Bombay Office during the year 1883-84:—

Second Class.
- Narayan Vinayek Raje finished his training on 19th April 1883 and was sent to Karachi.
- Minquel Fernandez was in training on the 31st March 1884, and was to be sent to Karachi.

Third Class.
- Passed Native Medical Pupil Solomon Ezekiel obtained his certificate on the 9th July 1883.
- Telegraph Master R. P. Stephens, trained on 13th July 1883, and employed at Sholapur (new site).
- 2nd Class Hospital Assistant Babaji Rawoot obtained his certificate on the 31st July 1883 and was subsequently employed at Jacobabad.

In addition to the above the following were trained locally:—

Second Class.
- Ramchandra Datto trained at Belgaum by his predecessor in September 1883 and by the Acting Meteorological Reporter in March 1884, and was employed as observer on 12th September 1883.

Third Class.
- Goolzar Sing trained by Telegraph Master R. P. Stephens at Sholapur, and employed at the old site on 1st November 1883.
- Shunker Rao trained by his predecessor and employed at Buldana on 1st June 1883.

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The suggested arrangements referred to in last year's report, for the better exposure of the instruments at Goa, were submitted by Mr. Martins to the Goanese Government and sanctioned; and a request was made to the Meteorological Office by the Portuguese Consul in Bombay for assistance in obtaining the necessary thermometer cage, solar thermometer stand, and a grass thermometer pad. With the sanction of the Government of Bombay these articles were sold to the Consul from the stock in hand.

Storm-warning Service.

No alteration in this service has been made during the past official year. Telegrams of the daily 10 hours observations have been received regularly from the following stations:—

Karachi.	Calicut.
Surat.	Cochin.
Ratnagiri.	Negapatam.
Karwar.	Madras.
Mangalore.	Masulipatam.

These, after reduction, have been, together with the observations from Bombay, curved and charted; and a written report of them has been daily posted up in the Port Office; also one copy of

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the report has been forwarded to the *Times of India*, and an abstract of it to the *Bombay Gazette*. Besides these regular telegrams, special ones, have been called for on special occasions.

Telegrams of a cautionary or re-assuring nature, or instructing that the storm-signals should be hoisted, have been issued as follows:—

Names of Ports.	Dates on which the telegrams were sent to hoist storm-signals.	Dates on which Cautionary telegrams were sent.	Date on which Re-assuring telegrams were sent.
Karachi . .	3rd July 1883	24th and 29th April, 22nd May, 3rd and 29th June, 2nd July, 19th October, and 11th November 1883.	4th July 1883.
Bhávnagar .	3rd July „	24th April, 22nd May, 2nd July, 19th October, and 11th November 1883.	.....
Daman . .	3rd July „	24th April, 22nd May, 2nd July, 19th October, and 11th November 1883.	.....
Bombay . .	.....	25th June 1883.	.....
Goa . . .	.....	2nd May and 5th October 1883.	.....
Vingorla . .	.....	2nd May 1883.	.....
Kárwár . .	.....	2nd May and 5th October 1883.	.....
Kumta . .	.....	2nd May 1883.	.....

As will be seen from the above list, the only storm of sufficient violence to make it necessary to hoist the storm-signals was that which crossed the peninsula at the end of June and beginning of July.

During my absence on tour, Mr. F. Chambers, the Acting Superintendent of the Government Observatory, Colaba, examined the daily weather charts and reports, and advised the office as to the calling in of special telegrams and the issue of storm-warnings.

The telephone which was fixed in the meteorological office in the month of August 1882, and is connected with the Bombay Central Telegraph Office, has, with the exception of two or three occasions, worked satisfactorily.

Special Work.

A brief sketch of the meteorology of the Bombay Presidency in 1882-83 was prepared in September last for the Bombay Government. During the writing of this sketch I made some discoveries of quantitative relations which had existed between previous and subsequent barometric movements in Western India during the years 1870 to 1883. I followed up these discoveries in a paper entitled "Some Results of an Examination of the Barometric Variations in Western India," which was submitted to the Royal Meteorological Society in February last, and has since been read at one of their meetings. The paper written by me last year on the "Transmission Eastwards round the Globe of Barometric Abnormal Variations" was published in *Nature* of August the 9th and 16th, 1883. I have worked out in detail and made complete drawings of the design for a component anemograph, of which mention was made in last year's report. I have also invented an entirely new form of vane, the object of which is to work with scarcely any friction, and yet without oscillation. I have also introduced some improvements into the design for the support of the anemograph cups. Drawings of the cups and vane, together with those of the resolving and recording apparatus, have been submitted with a descriptive paper to the Royal Meteorological Society. I have also been

engaged in an investigation of the barometric abnormals of Malegaon, and have obtained results which seem to throw light on the question of reduction to sea-level of barometric values at plateau stations. I have not yet been able to work up these results in the form of a paper.

Out-of-office hours I have made some comparisons between the meteorological and the health statistics of Bombay; but the fact pointed out in one of the recent reports of the Health Officer that the Health Statistics of Bombay are influenced in a very important degree by emigration, and that, until recent years, this fact had not been taken into consideration in compiling the Health Statistics, led me to desist for the time being from further labour on the subject.

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Office Establishment.

I remained acting as Meteorological Reporter for Western India up to the 6th June 1883, on which date, Mr. F. Chambers, the permanent incumbent, returned to duty. He held charge of the office up to the 18th June, when he was appointed to act as Superintendent of the Government Observatory, Colaba, and I, having been appointed by the Government of India to "continue" acting as Meteorological Reporter, resumed charge of the Meteorological Office. My appointment was subsequently sanctioned by the Secretary of State for India.

The other members of the office staff at the end of the year were as follows:—

Name.	Monthly Pay.
For Land Meteorology.	Rs.
Ganesh Sadashiv	57
Vajeram Jeeharam	42
Mahadev Ramchandra	40
Krishnaji Ramchandra	30
Ramchandra Sadashiv	30
For Storm-Warning Service.	
Ramchandra Govind	30
Anant Vishvamber	30

There is one menial on Rs. 10 per month; and a peon on Rs. 10 per month was sanctioned by the Government of India and engaged on the 11th August 1883.

I have during the year forwarded to Mr. Blanford a detailed statement of the work done by the office, and have asked his favourable consideration to certain proposals for an increase, both in the number of clerks and in the scale of pay of the present staff. It is difficult to see how the work of the office can be reduced to any useful extent without prejudicing the character of the meteorological returns. Great attention has always been paid to checking the observations; indeed this is, next to the computation, the most time-absorbing work in the office.

I have had every reason to be satisfied with the work of the clerks; they have all worked intelligently, and with care and diligence.

In conclusion, the thanks of the department are due to the various medical officers in charge of the observatories, many of whom have rendered valuable assistance.

A. N. PEARSON,
Acting Meteorological Reporter for Western India.

Meteorological Office, Bombay,
The 24th June 1884.

APPENDIX F II.

Names of the Superintendents and of the Observers who have officiated at the Observatories in Western India during the year 1883-84.

Station.	Class.	Superintendent.	Period. From	Period. To	Observer.	Date. From	Date. To	Remarks.
Karachi	Second	Surgeon-Major J. Paxton	1st April 1883	26th Mar. 1884	Private F. Bateman	1st April 1883	27th April 1883	
		Surgeon D. O. Sullivan	27th Mar. 1884	31st Mar. ,,	Narayen Vinayek Raje	28th April ,,	31st Mar. 1884	
Deesa	Ditto	Surgeon-Major F. Lyons	1st April 1883	9th July 1883	Ramkrishna Keshav Karandiker	1st April ,,	31st Mar. ,,	
		Surgeon G. J. Ward	10th July ,,	8th Oct. ,,				
		Surgeon-Major F. Lyons	9th Oct. ,,	31st Oct. ,,				
		Surgeon C. J. Ward	1st Nov. ,,	28th Nov. ,,				
		Surgeon-Major F. Lyons	29th Nov. ,,	14th Feb. 1884				
		Surgeon C. B. Maitland	15th Feb. 1884	23rd Feb. ,,				
		Surgeon-Major F. Lyons	24th Feb. ,,	31st Mar. ,,				
Verrowda (Poona)	Ditto	Ditto S. M. Salomon	1st April 1883	31st Mar. ,,	Narayen Sakharam Kelkar	1st April ,,	31st Mar. ,,	
Belgaum	Ditto	Ditto R. P. Ferguson	1st April ,,	31st Mar. ,,	Keshav Vishnu Apte	1st April ,,	11th Sep. 1883	
					Ramchandra Datta	12th Sep. ,,	31st Mar. 1884	
Jacobabad	Third	Surgeon J. McCloghry	1st April ,,	9th April 1883	Naryen Mane	1st April ,,	13th Sep. 1883	
		Ditto B. N. Koyaji	10th April ,,	18th April ,,	No Observer	14th Sep. ,,	16th Sep. ,,	
		Ditto K. H. Mistri	19th April ,,	2nd June ,,	Babajee Rawoot	17th Sep. ,,	31st Mar. 1884	
		Ditto B. N. Koyaji	3rd June ,,	31st Mar. 1884				
Bickaneer	Ditto	No Superintendent	.....	.....	Ram Lall	1st April ,,	31st Mar. ,,	
Hyderabad (Sind)	Ditto	Surgeon-Major H. M. Macbeth	1st April 1883	31st Mar. 1884	V. E. Nazareth	1st April ,,	31st Mar. ,,	
Bhuj	Ditto	Surgeon W. A. Barren	1st April ,,	31st Mar. ,,	Mahesh Bux Sing	1st April ,,	31st Mar. ,,	
Mount Abu	Ditto	Surgeon-Major Charles White	1st April ,,	29th Oct. 1883	Bapalal Mehta	1st April ,,	31st Mar. ,,	
		Ditto H. T. Chapman	30th Oct. ,,	28th Dec. ,,				
		Ditto Charles White	29th Dec. ,,	31st Mar. 1884				
Neemuch	Ditto	Ditto J. R. Croker	1st April ,,	30th April 1883	T. Bachu	1st April ,,	31st Mar. ,,	

		Sugreon S. J. Flood	1st May	,,	31st May	,,				
		Surgeon-Major J. R. Croker	1st June	,,	31st Mar.	1884				
Indore	Ditto	Ditto D. F. Keegan	1st April	,,	31st Mar.	,,	Trimbakrao	1st April	,,	31st Mar. ,,
Rajkote	Ditto	Ditto S. B. Haliday	1st April	,,	20th Mar.	,,	Solomon Samuel	1st April	,,	16th Jan. ,,
		Surgeon S. T. Avetoon	21st Mar.	1884	31st Mar.	,,	Keshav Govind	17th Jan.	1884	31st Mar. ,,
Surat	Ditto	Surgeon-Major J. Robb	1st April	1883	31st Mar.	,,	Dhunjibhai Motabhai	1st April	1883	31st Mar. ,,
Akola	Ditto	Surgeon J. J. Moran	1st April	,,	31st Mar.	,,	Samuel Gregory	1st April	,,	31st Mar. ,,
Amraoti	Ditto	Ditto T. Hume	1st April	,,	31st Oct.	1883	Mahomed Samsudin	1st April	,,	1st April 1883
		Apothecary W. E. Hendricks	1st Nov.	,,	30th Nov.	,,	Bukaram Pandrang	2nd April	,,	31st Mar. 1884
		Surgeon T. Hume	1st Dec.	,,	31st Mar.	1884				
Chikalda	Ditto	Ditto C. L. Swaine	1st April	,,	2nd Jan.	,,	Hiralal	1st April	,,	31st Mar. ,,
		Ditto R. James	3rd Jan.	1884	31st Mar.	,,				
Buldana	Ditto	Apothecary D. Callaghan	1st April	1883	31st Mar.	,,	Pandurang Krishnaji	1st April	,,	31st May 1883
							Shunker Ramrao	1st June	,,	31st Mar. 1884
Malegaon	Ditto	Surgeon P. J. Damania	1st April	,,	11th Dec.	1883	Gopal Cuddum	1st April	,,	11th Dec. 1883
		No Superintendent	12th Dec.	,,	5th Feb.	1884	Solomon Aaron	12th Dec.	,,	31st Mar. 1884
		Surgeon M. Collie	6th Feb.	1884	19th Feb.	,,				
		Ditto W. P. Carson	20th Feb.	,,	31st Mar.	,,				
Sholapur	Ditto	W. R. Scroggie, Esq., L.R.C.P.	1st April	1883	31st Mar.	,,	Atmaram Bapuji	1st April	,,	31st Oct. 1883
							Gulgarsing Luxman Sing	1st Nov.	,,	31st Mar. 1884
Ratnagiri	Ditto	Surgeon H. McCalman	1st April	,,	25th Sep.	1883	Mahadev Cuddum	1st April	,,	31st Mar. ,,
		Ditto Arthur Sargent	26th Sep.	,,	27th Mar.	1884				
		Ditto H. McCalman	28th Mar.	1884	31st Mar.	,,				
Zanzibar	Ditto	Ditto M. L. Bartholomeuz	1st April	1883	26th Nov.	1883	Surgeon M. L. Bartholomeuz	1st April	,,	20th April 1883
		No Superintendent	27th Nov.	,,	31st Mar.	1884	Abdur Rehman	21st April	,,	31st Mar. 1884
Karwar	Voluntary	R. G. C. Westbrook, Esq.	1st April	,,	31st Mar.	,,	G. W. M. D'Aranjo	1st April	,,	31st Mar. ,,
Calicut	Storm-warning Service.	Henry Richardson, Esq.	1st April	,,	31st Mar.	,,	F. D'Rozario	1st April	,,	31st Mar. ,,

APPENDIX G.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Madras for the year 1883-84.

During the official year under report observations were recorded as usual three times daily, *viz.*, at 10 A.M., 4 P.M., and 10 P.M., at twelve observatories, and twice daily, leaving out the 10 P.M. records, at 5 third class observatories. A new third class observatory was opened at Cuddapah on the 23rd of March 1884, and fresh instruments were provided wherever needed. Three of the observatories were inspected during the year.

A copy of the Madras Observatory Meteorological Register for each month is handed over to the Meteorological Reporter for the Presidency, which obviates the necessity of a separate record being maintained. No changes were made in the instruments used during the year. The following are the observatories which furnish meteorological registers :—

Madras.	Cuddapah.	Negapatam.
Amini Divi.	Kurnool.	Rajahmundry.
Bangalore.	Madura.	Salem.
Bellary.	Mangalore.	Secunderabad.
Cochin.	Masulipatam.	Trichinopoly.
Coimbatore.	Mercara.	Wellington.

Amini Divi (*Laccadives*).—The observations taken at this observatory were still very unsatisfactory, and the records that can be utilised this year are those of the barometer and dry and wet bulb thermometers.

The remuneration allowed to the Hospital assistant for his meteorological duties was withdrawn last year when the observations proved so unreliable, and he has since been transferred to another station, but, prior to this change, his successor, Syed Laul, was permitted by the Medical Department to attend my office for instruction in the additional meteorological work required. He came daily for about a month, during which time he was also taught to reduce the observations. The pay of the assistant at this observatory has been doubled, conditionally, that is, if the records and reductions prove satisfactory on revision at the Madras Office. A fresh anemometer was sent to Amini Divi by the new assistant, but, on arriving at his destination, he reported that one of the cups had come off.

Bangalore.—As usual, the work at this observatory has been very good throughout the year. No new instruments were required; the records were unbroken, and the assistant reduced and forwarded his observations with care and punctuality.

Bellary.—The ordinary observations three times a day; hourly observations on four days in each month, and the synoptic observations taken at the local time, corresponding to 7 A.M., Washington mean time, for the "United States International Weather Bulletin" were all carried on satisfactorily throughout the year.

I inspected this observatory on the 21st, 22nd, and 23rd of March last. The barometer was clean and in very good order, but the room in which it is placed is rather too small. The thermometer shed required a good many alterations, but, as Dr. Archdall informed me that it was under consideration to remove the Civil Dispensary some little distance off, and that all the meteorological instruments will have to be disturbed, I thought it better to defer the less important improvements

till later on. The thatching on the roof of the shed was scarcely thick enough, and the sides, instead of being open, were screened off by mats to within 3 feet of the south end, which, of course, prevented the free circulation of air. This, however, was soon taken down and set right, as at other observatories. Instead of neat posts and tarred ropes of telegraph wires to protect the shed and instruments from cattle, &c., there were only unsightly bamboo posts and string; these, however, will remain until the change. With the exception of the wet minimum, the thermometers were in fair order. * * * * As at all other observatories lately inspected, I substituted a teakwood thermometer cage for the open board on which the instruments had hitherto been placed, but only found it necessary to change one thermometer, the wet minimum. The assistants have worked better this year, reducing their observations thoroughly, but the delay in forwarding the reduced registers to me, frequently, six months in arrears, has still been a matter of complaint and serious inconvenience. In other respects I believe both the assistants do their best. No grass thermometer pad has ever been in use at this observatory, and, as there was not the least appearance of any grass under the thermometer, I think this fact accounts in a measure for the readings of the latter instrument sometimes exceeding those of the wet minimum. The present position of the thermometer shed is not a good one, being too near the Civil Dispensary, nor do I consider the anemometer sufficiently high. The new site pointed out to me by Dr. Archdall will doubtless be a great improvement upon the old one, being more open, and the anemometer will, it is hoped, also be raised a few feet, so that the surrounding trees will have no effect upon its readings.

Cochin.—The observations at this observatory have been continuous throughout the year, with the exception of the grass minimum thermometer, which was broken on the 30th of April, and could not be replaced owing to the insufficiency of the instruments in store at Madras. The readings of the anemometer are still unreliable, and, though a new instrument by Casella, previously compared with the Madras Observatory anemograph, was supplied, there was no improvement in the records. On further enquiry I was informed that the position of the instrument was most unsuitable, being fixed to the northern pole of the shed and only about 2 feet higher. There is also a near building almost facing the shed, and a large tree within a few yards; these, no doubt, prevent any accurate measurements of the velocity. I intend inspecting this observatory before long, when I hope to remedy the defects and make such improvements as may be found desirable.

The assistant employed at this observatory since November 1880 was transferred to the Madras Office in August, and M. V. Eippe appointed in his place. This new assistant, formerly employed in the Postal Department, had undergone the usual instruction at this office while on privilege leave, and since joining his appointment has worked very creditably.

Coimbatore.—The work at this observatory has been satisfactory throughout the year. The barometer and thermometers were in good order, and no new ones required. The anemometer is worn, and needs replacing, but its position is not satisfactory: and pending the construction of a staging on which the new instrument can be placed, the old one has been recorded. The assistant has reduced his observations regularly and carefully, and has been allowed to remain in the service a few months longer, though his age now necessitates early retirement.

Cuddapah.—A new third class observatory was started at this station on the 23rd of March 1884. A thermometer shed of the usual dimensions and design, together with as many instruments as were available from this office, were sent in charge of T. Vythianatha Iyer, first assistant, who, with the aid of the Executive Engineer, saw the shed erected, placed the thermometers in the cage, and taught an assistant the duties required of him. On the 25th of March I inspected this observatory myself, and was very well satisfied with all the arrangements. The shed occupies a good open position at the east end of the hospital compound, and there are fortunately neither trees nor buildings near enough to have any effect upon the readings of the instruments. As there were no good barometers, or sun and grass thermometers in store at Madras, the Meteorological

Reporter to the Government of India was requested to furnish these instruments from Calcutta, but they had not arrived at the time of my inspection. The medical officer in charge showed me the room in which he proposed placing the barometer, a very suitable one in every respect, and the instrument has since been received and placed there. The height of the cistern of the barometer, as ascertained by the Executive Engineer, is 433·36 feet above mean sea-level. The assistant appointed to take the observations is a man who can give his whole time to the meteorology, and will not be liable to be changed. The system of employing men who have other duties to perform and are likely to be transferred, has proved very objectionable and detrimental to one or two observatories of this Presidency, and, as there are numbers of applicants for vacant posts, I find no difficulty in getting assistants upon Rs. 15 per month. No anemometer is in use at this station at present, but, as it is proposed to place this instrument on the roof of the hospital, an inexpensive stand and ladder will be all that is necessary, and I hope this will soon be ready, and the records of all the instruments rendered complete.

Kurnool.—The work at this third class observatory was carried on steadily till October 1883 when the telegraph master was transferred, and a native postmaster, who had received no instructions regarding the observations, took charge. Since then the maximum readings of the thermometer have been unreliable, and the whole work deteriorated. Postmoster V. Venhataseshazza has applied to me to be allowed to resign his meteorological duties, and as soon as a new assistant, now under instruction at my office, is qualified, he will relieve the present postmaster. As the new assistant will have no other work, I shall be able to report more satisfactorily regarding this observatory in future reports.

Madura.—A break in the records of the wet bulb thermometer occurred from the 5th of March 1883 till the 4th of June, when another was supplied, but with this exception there has been no change in this observatory during the year.

Mangalore.—The work of this observatory has been carried on without interruption throughout the year, and the instruments appear to have been kept in good order, and no new ones required, Weekly records of the observations are forwarded to me by the telegraph master in charge.

Masluipatam.—The work at this observatory has been carried on without any breaks in the records, but the barometric readings were evidently wrong for some time, and though a new instrument was supplied from Calcutta in March of this year, there has been little improvement. The assistant only reduced his observations for two or three months during the year, and even then they were so incorrect that I had to set the Madras Meteorological Office assistants to do the work over again for those months. Since March his salary has been reduced to half, but even this has failed to realise any improvements, and, in consequence, he will soon be superseded by a more competent and willing man.

Mercara.—No new instruments were needed at this observatory, and the work has been carried on in a satisfactory way throughout the year. Weekly records of the observations are regularly furnished to this office.

Negapatam.—The observations were carried on without any interruption throughout the year, and the instruments appear to have been in good order. During heavy rain the readings of the grass mininum have occasionally exceeded those of the wet minimum by a degree or even more. The assistant has worked well, reducing his observations more carefully than formerly.

Salem.—This observatory has kept its good reputation throughout the year. No new instruments were required, and the assistant has reduced his observations satisfactorily and forwarded them punctually to this office.

Secunderabad—This observatory was inspected on the 17th of March last, when I altered the arrangement of the thermometers, exchanging the thermometer board hitherto in use for a teakwood and wire cage, similar to those now used at all the observatories visited since the Department has been under my care. The general condition of the observatory was very satisfactory and highly creditable to both the medical officer in charge and his assistant. The barometer and all the other

instruments were clean and in perfect order. The shed will require renovating and painting before long, and the railings which enclose the raingauge and radiation thermometers will be better extended right round the shed to prevent cattle when grazing near, from making an occasional meal of the thatching from the roof (an estimate for this little improvement had been submitted to me prior to my visit), and I understand the assistant has frequently had to watch the shed to prevent this from occurring. With the exception of the dry maximum thermometer, which was replaced by another in December, and the sun maximum thermometer broken in January, the remaining instruments were in good order throughout the year. The observations have been carefully and accurately reduced by the new assistant since his appointment, and this observatory, formerly the worst, now ranks as one of the best in the Presidency.

Trichinopoly.—The observations of this second class observatory have been carried on without any breaks all through the year under report, but the continued obstinacy of the assistants in not furnishing this office with the reductions till many months have elapsed is still a source of complaint, and has even delayed the publication of this Annual Report, as the table of yearly means and extremes cannot be completed until all the registers from up-country observatories have been received and revised.

Wellington.—No changes have been made in any of the instruments in use at this observatory, and the work has been carried on satisfactorily throughout the year, with the exception of three days in December, the 8th, 9th, and 10th, on which occasions the records were missed, owing to the indisposition of the acting assistant during the absence, on leave, of Serjeant Brownsell. As the medical authorities required the room which had hitherto been given up to the assistant as a meteorological office, and in which the barometer had been kept, this instrument was removed to another room on the same floor, at the back of the hospital after the 10 P.M. reading on the 31st of January.

The general work of the observatories of the Madras Presidency has been satisfactory during the year. With the exceptions of Cochin and Kurnool there have been no changes in the assistants. The observations have been reduced, some partially and others completely, by all the assistants, excepting the one at Masulipatam, and since the commencement of 1884 I am pleased to be able to report a still further improvement with regard to the registers. It has, however, been a difficult matter to get the assistants drawing the higher rate of salary to complete their work, and the inaccuracy of some of the figures at first necessitated complete revision at my office.

The list of new instruments supplied is considerably smaller this year when compared with that in last year's report.

* * * * * *

The establishment of the Madras Meteorological Office has been increased by the sanction of a copying clerk, a very necessary addition, and one that will enable me to keep the work up to date in future. The following is the present staff employed at my office :—

T. Vythianatha Iyer	First Assistant.
N. E. Kangayam Pillay	Second ,,
N. Narayansawmy	Third ,,
David John	Fourth ,,
Bungaroo	Peon.

Revenue Board Rain Reports have been received as usual by the Government Astronomer, and the results tabulated in the Supplement to the *Fort St. George Gazette* * * * * * * The rain stations have not yet been handed over to the Meteorological Reporter.

ELIZABETH ISIS POGSON, F. R., MET. SOC.,
Meteorological Reporter to the Government of Madras.

METEOROLOGICAL OFFICE,
Madras, 15th July 1884.

APPENDIX G II.

List of Officers in charge and Assistants in the Madras Presidency, Meteorological Department, in the official year 1883-84.

Station.	Officer in charge.	From	To	Assistant.	From	To
Amini Divi	Syed Abdool Rahaman	22nd Dec. 1879	5th Feb. 1884.			
	Syed Laul	6th Feb. 1884	31st Mar. ,,			
Bangalore	Surgeon P. H. Benson, M.B.	1st April 1881	14th Sep. 1883	Rungasawmy Moodeliar	1st Sep. 1871	31st Mar. 1884.
	,, A. F. Dobson, M.B.	15th Sep. 1883	19th Feb. 1884.			
	Surgeon-Major J. North	20th Feb. 1884	31st Mar. ,,			
Bellary	,, H. M. G. Archdall	11th Feb. 1881	31st Mar. ,,	B. G. Sashachellum, First	31st Aug. 1878	31st Mar. ,,
				Sreenevasa Row, Second	21st Dec. 1881	31st Mar. ,,
Cochin	Brigade-Surgeon W. H. Morgan	24th May 1882	31st Mar. ,,	G. Narayanasawmy	7th Nov. 1880	17th Aug. 1883.
				M. V. Eippe	18th Aug. 1883	31st Mar. 1884.
Coimbatore	Surgeon-Major J. F. Fitzpatrick, M.D.	2nd May ,,	31st Mar. ,,	Varadiah Naidu	1st July 1877	31st Mar. ,,
Cuddapah	Surgeon G. Iyasawmy	15th Mar. 1884	31st Mar. ,,	V. A. Vyaravalu Moodeliar	15th Mar. 1884	31st Mar. ,,
Kurnool	Telegraph Master A. Wale	12th Feb. 1883	12th Aug. 1883.			
	,, ,, A. Holmes	13th Aug. ,,	10th Oct. ,,			
	Post and Telegraph Master V. Venkatasubbaraya.	20th Oct. ,,	31st Mar. 1884.			
Madura	Surgeon Major W. J. Hastings, M.D.	16th Oct. 1882	31st Mar. ,,	V. Sashachellum	19th Nov. 1867	31st Mar. ,,
Mangalore	Telegraph Master F. D'Souza	22nd Aug. 1880	17th Jan. ,,			
	,, ,, A. Ramarow	18th Jan. 1884	9th Feb. ,,			
	,, ,, R. S. D'Souza	10th Feb. ,,	31st Mar. ,,			
Masulipatam	Surgeon H. St. Clare Carruthers	9th April 1882	8th Nov. 1883	Uma Ranganayakulu Naidu	1st Aug. 1868	31st Mar. ,,
	Surgeon-Major J. H. Ritchie	9th Nov. 1883	31st Mar. 1884.			
Mercara	Telegraph Master H. Duckworth	24th Mar. 1880	31st Jan. ,,			
	Deputy Tel. Master T. S. Arunachellum	22nd Jan. 1884	26th Jan. ,,			
	Telegraph Master H. Duckworth	27th Jan. ,,	3rd Mar. ,,			
	Deputy Tel. Master T. S. Arunachellum	4th Mar. ,,	12th Mar. ,,			
	Telegraph Master H. Duckworth	19th Mar. ,,	31st Mar. ,,			

List of Officers in charge and Assistants in the Madras Presidency, Meteorological Department, in the official year 1883-84.

Station.	Officer in charge.	From	To	Assistant.	From	To
Negapatam	Surgeon E. A. Morris, L.R.C.P.	15th Nov. 1880	31st Mar. 1884	S. Saminatha Iyer	5th Sep 1874	31st Mar. 1884.
Salem	Surgeon-Major H. J. Haziett	26th May 1882	.....	L. Ramsing	13th Oct. 1880	31st Mar. ,,
	Do. A. L. Hackett	.....	31st Mar. 1884.			
Secunderabad	Do. E. Fawcett, F.R.C.S.	1st April 1883	6th April 1883	J. F. Williams	27th Feb. 1882	31st Mar. ,,
	Surgeon G. F. Bevan	7th April ,,	6th July ,,			
	Surgeon-Major E. Fawcett, F.R.C.S.	7th July ,,	12th Oct. ,,			
	Do. T. C. H. Spencer	5th Nov. ,,	7th Nov. ,,			
	Surgeon G. F. Bevan	8th Nov. ,,	14th Dec. ,,			
	Surgeon-Major T. C. H. Spencer	15th Dec. ,,	31st Mar. 1884.			
Trichinopoly	Do. J. B. Thomas, L.R.C.P.L.	3rd Dec. 1879	12th July 1883	T. Lutchman Row, First	21st Nov. 1874	31st Mar. ,,
	Surgeon J. L. Evan Gezzel, M.D.	13th July 1883	26th July ,,	E. M. Bhajarajooloo Naidee, Second	1st December 1881	31st Mar. ,,
	Surgeon-Major L. C. Nanney	27th July ,,	31st Mar. 1884.			
Wellington	Do. A. Long, M.D.	3rd Nov. 1882	24th Oct. 1883	Sergeant H. Brownsell	1st August 1880	31st Mar. ,,
	Surgeon R. T. Beamish, M.D.	25th Oct. 1883	16th Nov. ,,			
	Surgeon-Major C. F. Churchill, M.D.	17th Nov. ,,	31st Mar. 1884.			

APPENDIX H.

Report on the Administration of Meteorological Observatories in British Burma by the Sanitary Commissioner.

During the year all the Observatories in the province were inspected by me—

2nd class, Rangoon, on 12th February 1884.
3rd class, Bassein, on 13th and 14th June 1883.
3rd class, Thayetmyo, on 12th October 1883.
3rd class, Moulmein, on 20th December 1883.
3rd class, Mergui, on 9th December 1883.
3rd class, Toungoo, on 2nd August 1883.

The position of the last-named has since my inspection been changed from the Military Hospital Compound to that belonging to the Civil Dispensary.

All records were found up to date and appeared to be accurately kept.

Instruments, with the following exceptions, were clean, well-placed, and in good working order.

At Rangoon the clock-work in connection with the anemograph had stopped since 10 A.M. on the day of inspection. The observer explained that cockroaches and other vermin constantly get amongst the gearing and bring the clock-work to a standstill. Such alterations were recommended as, it is hoped, will prevent a recurrence of similar accidents. The wind-vane appeared to be working stiffly, and an officer of the Public Works Department was asked to put it to rights.

At Bassein the solar radiation thermometer had been broken by a monkey. It has since been replaced.

At Mergui the grass radiation thermometer had been broken by a piece of bone believed to have been dropped by a crow or other large bird.

At Moulmein, the grass radiation thermometer had been accidentally broken.

The accompanying lists show—

(*a*) The Superintendents and Observers for the year.

(*b*) The instruments issued to each Observatory.*

D. SINCLAIR, M.D.,
Sanitary Commissioner, British Burma

RANGOON,
5th July 1884.

* This is incorporated in the general return in Appendix K

APPENDIX H II.

Return showing the names of Superintendents and Observers of the Meteorological Observatories in the Province of British Burma for the year 1883-84.

Name of Station.	Designation of Officer.	Name and Rank of Officer.	Term of Service.
Rangoon	Superintendent	Surgeon-Major H. Johnstone, M.D.	From 22nd April 1880 to 27th August 1883.
	Offg. Ditto	Ditto O. Baker	„ 28th August to 27th November 1883.
	Ditto	Ditto H. Johnstone, M.D.	„ 28th November and 29th November 1883.
	Offg. Ditto	Ditto O. Baker	„ 30th November 1883 to 15th January 1884.
	Superintendent	Ditto H. Johnstone, M.D.	„ 16th January to 31st March 1884.
	Observer	G. E. Wales	„ 1st August 1882 to 31st March 1884.
	Assistant Observer	Meh Nego	„ 1st December 1882 to 15th September 1883.
	Ditto	O. White	„ 16th September 1883 to 31st March 1884.
Bassein	Superintendent	Surgeon S. H. Dantra, M.D.	„ 1st November 1881 to 31st March 1884.
	Observer	Moung Hpay	„ 14th February 1883 to 31st March 1884.
Thayetmyo	Superintendent	Surgeon O. Baker	„ 1st April to 25th August 1883.
	Ditto	Ditto E. P. Frenchman	„ 26th August 1883 to 26th February 1884.
	Ditto	Ditto Charles W. E. Foster	„ 27th February to 31st March 1884.
	Observer	Mirza Mahomed Tphya Begg, 3rd Class Hospital Assistant.	„ 1st April to 31st December 1883.
	Ditto	Alla Deen, 2nd Class Hospital Assistant.	„ 1st January to 31st March 1884.
Moulmein	Superintendent	Surgeon-Major W. F. de Fabeck, M.D., Civil Surgeon.	Throughout the year.
	Observer	F. St. Hilbert, Hospital Assistant	
Mergui	Superintendent	Hospital Assistant Rajub Ally	From 1st to 13th April 1883.
	Ditto	Uncovenanted Medical Officer, Paul George Paul.	„ 14th April 1883 to 31st March 1884.
	Observer	Moosajee	„ 1st April 1883 to 31st March 1884.
Tounghoo	Superintendent	Surgeon Maurice Smith	„ 1st April to 30th July 1883.
	Ditto	Ditto P. W. Dalzell	„ 31st July to 31st March 1884.
	Observer	1st Class Hospital Assistant M. Baboo Pillai.	„ 1st April 1883 to 31st March 1884.

D. SINCLAIR, M.D.,
Sanitary Commissioner, British Burma.

APPENDIX I.

Return of the Stock and Issue of Instruments for the year 1883-84.

Instruments.	In Store on 1st April 1883.	Received 1883-84.	Issued 1883-84.
Van Rysselberghe's meteorograph	1	...	...
Barometers, observatory, Fortin's principle	8	5	5
Do. do. Kew principle	3	28	23
Do. mountain, portable tripod (Adie)	18	5	11
Do. marine, Kew principle	22	1	14
Do. Newman's, large standard	2	...	...
Do. do. small standard	3	3	4
Do. Negretti and Zambra (various)	7	2	5
Aneroids	19	2	2
Thermometers standard with attached scales	20	...	3
Do. without attached scales (chemical)	1	...	...
Do. for hygrometers (Kew pattern)	80	52	63
Sling thermometers	10	...	...
Thermometers, maximum, for shade	123	10	51
Sun thermometers not in vacuo	2	...	...
Thermometers minimum for shade	52	44	46
Do. do radiation	31	25	33
Six's thermometers	...	6	...
Thermometers, solar, in vacuo	38	33	13
Fra..kland's sun thermometer	...	6	1*
Ponillet's pyrheliometer	1	...	...
Stewart's actinometers (thermometers for)	...	12	12
Lenses for actinometers	...	3	3
Hodgkinson's do.	2	...	...
Herschell's do.	1	...	...
Regnault's hygrometer	3	...	...
Daniell's do.	10	...	...
Halleur's do.	5	..	
Boiling point thermometers	6	1	...
Pocket spectroscopes (Browning's)	2	...	...
Wind vanes	17	14	23
Anemometers	26	45	43

* Broken.

Return of the Stock and Issue of Instruments for the year 1883-84—continued.

Instruments.	In Store on 1st April 1883.	Received 1883-84.	Issued 1883-84.
Beckley's anemographs	2	...	...
Raingauges (Symons' and Glaisher's)	6	37	33
Measure glasses for do.	18	72	55
Reading lenses	3	1	3
Sun thermometer stands	20	...	6
Radiation pads	3	5	8
Thermometer cages	4	27	28
Do. for ships	15	...	...
Prismatic compass	1	...	...
Sand glasses (3 minutes)	5	80	39
Sunshine recorder	1	...	...
Bull's eye lantern	1	...	...
Salinometers	36	...	...
Common thermometers, brass scales	28	...	1
Clocks	2	8	8
Watches	...	2	1
Spirit level	1	...	...
Hick's barograph	1	...	...
Thermograph with Negretti's and Zambra's sets of recording thermometers	1	...	...
Sundials	...	2	2
Magnetic compasses (pocket)	...	4	4

APPENDIX K.

Return of the Instruments issued to each Observatory in 1883-84.

Provinces.	Stations.	Barometers.	Hygrometers: Dry bulb.	Hygrometers: Wet bulb.	Dry maximum thermometers.	Minimum thermometers: Dry.	Minimum thermometers: Wet.	Radiation thermometers: Solar.	Radiation thermometers: Grass.	Anemometers.	Wind Vanes.	Raingauges.	Measure-glasses.	Lenses.	Clocks.	Sand-glasses.	Stands for sun thermometers.	Pads for grass radiation thermometers.	Cages.	Standard thermometers.	Compasses.	Sundials.	Remarks.
Africa.	Zanzibar	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	1*	...	* In lieu of one lost.
Persia.	Bushire	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	
Beloochistan	Quetta	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Chamba	4	1	1	1	1	1	...	1	1	1	1	2	...	1	...	...	1	1	...	...	...	Original furniture.

Return of the Instruments issued to each Observatory in 1883-84—contd.

Provinces.	Stations.	Barometers.	Hygrometers. Dry bulb.	Hygrometers. Wet bulb.	Dry maximum thermometers.	Minimum thermometers. Dry.	Minimum thermometers. Wet.	Radiation thermometers. Solar.	Radiation thermometers. Grass.	Anemometers.	Wind Vanes.	Rain-gauges.	Measure-glasses.	Lenses.	Clocks.	Sand-glasses.	Stands for sun thermometers.	Pads for grass radiation thermometers.	Cages.	Standard thermometers.	Compasses.	Sundials.	Remarks.
Cashmere.	Leh	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	12 thermometers for actinometers and three lenses have been sent to Mr. Hennessey at Mussooree for verification.
Punjab.	Kailang	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	
	Lahore	...	...	...	...	...	...	2†	1†	...	...	...	...	...	...	...	...	...	...	...	...		
	Mooltan	...	...	...	...	...	...	1‡	...	...	...	...	...	...	1	1†	...	...	...	...	..	...	
	Dera Ismail Khan	...	...	...	...	...	...	...	1‡	...	...	...	...	...	...	1†	...	...	...	...	...	...	
	Peshawar	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	1*	...	...	...	...	...	...	* New Instruments.
	Rawalpindi	...	...	...	...	...	...	...	1*	...	...	...	...	...	1*	1*	...	...	...	...	...	.	
	Murree	...	...	...	...	...	...	...	3‡	1†	1‡	...	...	...	...	1*	...	...	...	...	...	..	† Substituted for old ones.
	Sealkot	...	...	...	...	...	1†	...	1†	...	...	...	...	...	...	1†	...	...	...	...	...	...	‡ Substituted for broken ones.
	Ludhiana	...	...	...	1†	...	1‡	...	...	...	...	..	...	...	...	1†	...	...	.	...	...	...	
	Sirsa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1†	...	...	...	...	...	...	
	Delhi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1†	...	...	...	...	..	...	
	Simla	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	
N.-W. P. and Oudh.	Allahabad (Muir College)	...	...	...	1	1	...	...	...	...	..	...	...	...	...	...	...	...	...	...		...	
	Allahabad (New observatory)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3§	..	...	§ For ground observations.
	Meerut	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	..	..	..	...	
	Agra	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...		...	...	
	Roorkee	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	..	..	..	
	Mussooree	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	..	..	.	...	
	Lucknow	...	...	...	...	...	...	1	...	..	...	...	...	...	...	...	1	...	..		...		
	Ranikhet	...	...	...	1	...	...	...	...	...	...	...	...	...	1	1	...	...	.	.	...	...	
	Bareilly	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	.	...	...	...	
	Chakrata	...	...	...	...	...	...	1	...	..	.	...	...	...	.	1	...	.	.	.	.	..	
	Benares	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	.		.	..	
	Gorakhpur	...	...	...	...	...	..	...	...	...	...	...	...	...	1	1	...	...	...		...	..	
	Jhansi	...	...	...	...	...	...	...	...	..	...	...	...	...	.	1	..		..	..	..	...	
Assam.	Sibsagar	...	...	...	1	...	...	...	...	...	...	...	1	1	...	...	...		.	...		..	
	Dhubri	...	...	...	...	...	...	...	1	...	...	..	...	...	...	...	...	...	...	...		..	
	Silchar	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	..	...	..	
	Purneah	...	...	...	...	...	...	...	1	..	...	...	...	...	...	1	...	...	...	..	..	...	
Bengal.	Burdwan	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	.	..	.	.		...	
	Darjeeling (St. Paul's School)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	..	1	.	...	..		
	Dúrbhanga	...	...	...	...	...	...	...	...	...	...	...	...	...	1		...	..	..				
	Patna	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	..	.	...	.	
	Gya	1‖	...	1‖	...	...	1‖	...	...	1‖	...	...	...	...	...	1	...	...		...		.	¶ To replace defective instruments.

Return of the Instruments issued to each Observatory in 1883-84—contd.

Province.	Stations.	Barometers.	Hygrometers. Dry bulb.	Hygrometers. Wet bulb.	Dry maximum thermometers.	Minimum Thermometers. Dry.	Minimum Thermometers. Wet.	Radiation Thermometers. Solar.	Radiation Thermometers. Grass.	Anemometers.	Wind Vanes.	Raingauges.	Measure-glasses.	Lenses.	Clocks.	Sand-glasses.	Stands for sun thermometers.	Pads for grass radiation thermometers.	Cages.	Standard thermometers.	Compasses.	Sundials.	Remarks.
Bengal—*contd.*	Hazaribagh	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	**	...	...	...	
	Jessore	...	...	...	...	...	...	...	*	...	...	...	...	...	...	...	...	1	...	...	...	...	
	False Point	1	...	...	...	...	...	...	...	1*	...	...	...	...	...	1	...	...	...	...	...	...	
	Chittagong	...	...	...	...	...	1	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	
	Saugor Island	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	
	Gopalpore	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	
	Balasore	1	1	1	1	1	...	...	...	1*	1	1	1	...	...	...	...	...	...	...	...	...	
	Midnapore	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	..	...	
	Raneegunge	1	1	1	1	1	...	...	...	1	1	1	1	...	1	...	...	...	...	...	...	...	
	Noakhally	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	* To replace defective instruments.
	Burrisaul	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Serajgunge	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Commillah	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Furreedpore	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Mymensing	1	3	2	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Rampore Beauleah	1	1	1	1	1	...	...	...	1	1	1	1	1	...	...	...	...	...	...	...	...	
	Dinagepore	1	1	1	1	1	...	...	...	1	1	1	1	1	1	...	...	...	...	...	...	...	
	Rungpore	1	1	1	1	2†	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	† One out of order in transit.
	Julpigoree	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Bhágulpore	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Chupra	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Motihari	2	1	1	2	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Buxar	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Arrah	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Dehree	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Nya Doomka	1	1	1	1	1	...	...	...	1	1	1	1	...	...	..	...	...	...	...	...	...	
	Ranchee	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	
	Chyebassa	1	1	1	1	1	...	...	..	1	1	1	1	...	...	...	...	...	...	...	...	...	
Central Provinces.	Nagpur	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Jubbulpore	3	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Pachmarhi	...	...	...	...	...	...	...	3	...	...	...	1	...	...	...	...	...	...	...	...	...	
	Saugor	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Hoshangabad	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Khandwa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Seoni	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Raipur	1	...	1	...	...	1	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	
	Sambalpore	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Chanda	.	...	...	...	...	...	...	...	1	...	...	1	..	...	...	...	...	...	...	...	...	

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Return of the Instruments issued to each Observatory in 1883-84—contd.

Province.	Stations.	Barometers.	Hygrometers. Dry bulb.	Hygrometers. Wet bulb.	Hygrometers. Dry maximum thermometers.	Minimum Thermometers. Dry.	Minimum Thermometers. Wet.	Radiation Thermometers. Solar.	Radiation Thermometers. Grass.	Anemometers.	Wind Vanes.	Raingauges.	Measure-glasses.	Lenses.	Clocks.	Stand-glasses.	Stands for sun thermometers.	Pads for Exposed radiation thermometers.	Cages.	Standard thermometers.	Compasses.	Sundials.	Remarks.
Berar.	Chikalda	...	...	...	...	...	...	...	...	...	...	...	...	...	1*	...	...	...	.	...	...	...	* In lieu of one out order.
	Akola	...	...	...	...	...	...	1*	...	..	...	..	...	1	1*	...	...	...	.	...	...	...	
	Amraoti	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	..	1*	...	.	...	.	
Central India.	Indore	...	...	...	...	...	...	...	...	...	...	...	...	...	1*		...	...	...	..	...	...	
Rajputana.	Bickaneer	...	...	...	1*	...	...	...	1†	..	...	..	...	..	...	...	...	...	...	...	...	...	† In lieu of one broken.
	Sambhar	..	...	2	...	...	...	1	...	..	...	...	...	...	...	...	...	...	...	...	...	...	
	Ajmere	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Pachbudra	...	...	...	...	...	...	...	2	1	...		...	..	2‡	...	..	...	...	...	...	...	‡ One watch and one clock.
Bombay.	Jacobabad	...	...	...	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	.	...	
	Hyderabad	...	...	...	1*	...	...	...	1†	1*	...	...	...	...	...	...	...	...	.	...	...	...	
	Kurrachee	...	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Bhuj	...	...	...	...	1†	...	...	...	1*	...	...	...	...	...	...	...	...	...	...	...	...	
	Deesa	...	...	...	...	...	...	...	1†	...	.	...	...	...	...	...	...	...	...	...	...	...	
	Rajkot	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	..	...	...	...	..	...	
	Malegaon	...	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	..	...	..	...	...	...	
	Poona	...	...	...	...	...	...	...	1†	...	...	...	1†	...	...	...	...	...	...	...	...	...	
	Sholapur (old obsy.)	...	...	...	...	...	...	...	1†	...	...	...	...	...	...	1§	...	...	...	...	...	...	§ In lieu of one stolen.
	„ (new „)	1	1	1	1	1	1	1	1	1	...	1	1	...	...	...	1	2	...	...	1	...	
	Belgaum	...	...	...	...	...	1†	...	...	...	...	...	...	.	...	...	...	...	...	...	...	...	
	Ratnagiri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1*	...	...	...	...	
	Karwar	...	...	...	...	...	...	...	...	...	..	...	...		2*	...	...	...	...	...	...	...	
	Baroda	1	1	1	1	1	1	1	1	1	...	1	1	...	...	1	1	2		...	1	...	
Madras, Mysore, and Coorg.	Bellary	...	...	...	...	...	1	1	...	...	...	...	.	...	...	...	...	..	.	...	.	...	
	Trichinopoly	...	...	...	..	...	...	...	...	1	...	...	.	...	...	1	...	...	...	..		...	
	Masulipatam	1	..	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	.	...	
	Madura	...	1	1	...	...	...	...	.	...	...	...	...	...	.	1	..	...	...	..	..	...	
	Salem	...	...	...	...	.	...	...	..	...	.	...		...	...	1	..	...		...	..	...	
	Coimbatore	...	...	...	...	...	...	...	...	...		...	...	...	..	1	...	. .	..	..		...	
	Wellington	...	..	...	..	...	...	...	...	...	...	.	...	...	..	1	...	..		...	...	..	
	Negapatam	1	...	...	...	...	..	...	...	...	..	.	..	..	...	...	...	...	...		..	...	
	Bangalore	..	.	...	...	...	..	.	...	...	...	...	...	...	...	1	...	..	.	...	...	...	
	Kurnool	.	...	...	...	...	1	1	1	..	...	...	...	..	.	1	...	..	.	...	...	.	
	Cuddapah	1	1	1	1	1	1	1	1	...	1	1	1	...	...	...	1	1	...	..	..	...	
	Rajamundry	1	...	...	...	...	...	1	1	...	...	...	...		...	...	1	1	...	...		...	
	Secunderabad	...	...	...	1	...	...	1	...	...	...	...	...	...	.	.		...	...	...	...	...	
	Mercara	...	...	...	...	...	...	..	...	...	...	.	.	...	...	1	.	...	...	...	.	...	
	Amini Divi	...	..	...	...	...	...	...	...	1	..	...	..	..	.	...	...	. .	...	...	...	...	

Return of the Instruments issued to each Observatory in 1883-84—concld.

Province.	Stations.	Barometers.	Hygrometers. Dry bulb.	Hygrometers. Wet bulb.	Dry maximum thermometers	Minimum thermometers. Dry.	Minimum thermometers. Wet.	Radiation thermometers. Solar.	Radiation thermometers. Grass.	Anemometers.	Wind Vanes.	Raingauges.	Measure-glasses.	Lenses.	Clocks.	Sand-glasses.	Stands for sun thermometers.	Pads for glass radiation thermometers.	Cages.	Standard thermometers.	Compasses.	Sundials.	Remarks.
Burma.	Rangoon	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Thyetmio	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Bassein	...	...	...	1*	1*	1*	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	* Replacing those stolen from observatory.
	Tounghoo	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	
	Moulmein	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	
	Mergui	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bay Islands.	Port Blair	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Nancowry	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	† Frankland's sun thermometer.
	Alipore	...	...	...	1	1	...	1†	...	1‡	...	...	...	...	...	...	...	1	...	...	...	...	‡ Beckley's self-registering anemometer.
	F. L. V. *Planet*	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Dehra (Forest School)	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Ajmere (Forest Dept.)	...	2	2	2	2	2	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	
	Makhla	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Mominabad	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	
	Erinpura	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	
	Lohardugga	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	
	Cuttack (Tributary Mehals)	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	

APPENDIX L.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	The Editor of the *Delhi Gazette*.
Ajmere	Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Director of the Meteorological Service of the Ecole des Sciences d'Alger.
Allahabad	Secretary to the Government, North-Western Provinces and Oudh.
	Department of Revenue and Agriculture, North-Western Provinces and Oudh.
	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
	Editor of the *Pioneer*.
	The Accountant-General, North-Western Provinces and Oudh.
Amsterdam	Royal Academy of Sciences.
Bangalore	Chief Commissioner, Mysore and Coorg.
	Conservator of Forests, Mysore and Coorg.
Batavia, Java	Meteorological Observatory.
Berlin	Ditto Institute.
Bombay	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.

List of Recipients of the Publications of the Meteorological Office—continued.

Bombay—*contd.*	Sanitary Commissioner with the Government of Bombay.
	Bombay University.
	Asiatic Society of Bombay.
	Sassoon Mechanic's Institute.
	Geographical Society of Bombay.
	Editor of the *Bombay Gazette.*
	Ditto *Times of India.*
	Elphinstone College.
Brisbane, Queensland	Observatory.
Brussels	Royal Academy of Sciences.
	Observatoire Royal.
Budapesth	Observatory.
Calcutta	Secretary of State for India (through Revenue and Agricultural Department
	Secretary to the Government of India, Revenue and Agricultural Department
	Ditto ditto Home Department.
	Ditto ditto Public Works Department.
	Ditto ditto Foreign Department.
	Ditto ditto Department of Finance and Commerce
	Ditto ditto Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor General of India.
	Superintendent, Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanical Gardens, Calcutta.
	Inspector-General of Forests, with the Government of India.
	Surgeon-General ditto ditto.
	Asiatic Society of Bengal.
	Indian Museum Library.
	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the *Calcutta Review.*
	Ditto *Statesman and Friend of India.*
	Ditto *Englishman.*
	Ditto *Indian Daily News.*
	Ditto *Hindu Patriot.*
	Ditto *Indian Agriculturist.*
	St. Xavier's College Observatory.
	The Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
Cambridge	University Library (through H.M.'s Secretary of State for India).
Cambridge, Massachusetts	Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Chemnitz	Royal Meteorological Institute.
Chatham	Royal Engineer's Library (through Revenue and Agricultural Department
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
Colombo	Editor of the *Ceylon Times.*
	Ditto *Ceylon Observer.*
	Surveyor General of Ceylon.

List of Recipients of the Publications of the Meteorological Office—continued.

Constantinople	Observatoire Impérial Météorologique.
Copenhagen	Danske Meteorologiske Institut.
	Royal Danish Academy of Sciences.
Cordoba	Meteorological Office.
Darjeeling	Conservator of Forests, Government of Bengal.
Dehra Dun	Editor of the *Indian Forester*.
	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Dublin	Royal Dublin Society.
Dacca	Dacca College.
Edinburgh	Scottish Meteorological Society.
	Astronomer Royal for Scotland, Royal Observatory.
Ellichpore	Assistant Conservator of Forests, Melghat Division.
Goa	Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Guatemala	Observatorio Meteorologico del Institut Nacional de Guatemala.
Hamburgh	Nord Deutsche Seewarte.
Havana	Real Collegio de Belen.
Hong-Kong	Observatory.
Indore	Agent to the Governor General for Central India in charge of the Residency.
Iowa, U. S.	Iowa Weather Service.
Jeypore	Maharajah's Observatory.
Jubbulpore	Civil Surgeon of Jubbulpore.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests, Bombay, Sind Division.
Lahore	Secretary to the Government of the Punjab.
	Meteorological Reporter ditto ditto.
	Sanitary Commissioner ditto ditto.
	Conservator of Forests ditto ditto.
	Editor of the *Indian Public Opinion*.
Lisbon	Observatoire de Infante d'Luiz.
	Academy of Sciences.
London	Meteorological Council.
	Royal Society.
	Royal Asiatic Society (through H.M's Secretary of State for India).
	Society of Arts.
	Institution of Civil Engineers.
	Royal School of Mines.
	Royal Meteorological Society.
	Admiralty Library.
	United Service Museum.
	British Museum (through H. M.'s Secretary of State for India).
	Editor of the *Philosophical Magazine*.
	Ditto *Athenæum*.
	Ditto *Nature*.
	Ditto *Symon's Monthly Meteorological Magazine*.
	Ditto *Westminster Review*.
	Ditto *Quarterly Review*.
Madras	Secretary to the Government of Madras.
	Ditto ditto Public Works Department.
	Meteorological Reporter to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, Government of Madras.

List of Recipients of the Publications of the Meteorological Office—continued.

Madras	Madras University.
	Editor of the *Madras Times*.
	Ditto *Madras Athenæum*.
	Ditto *Madras Mail*.
	Superintendent, Government Central Museum.
	The Agricultural Reporter, Government of Madras, Saidapet.
	Surgeon General, British Medical Department.
	Ditto Indian Medical Department.
	Master Attendant of Madras.
	Conservator of Forests, Northern Circle.
Madrid	Royal Observatory.
Magdeburgh	Principal of the Observatory of the Magdeburgh Zeitung.
Manchester	Literary and Philosophical Society.
Manila	Meteorological Observatory.
Mauritius	Meteorological Society.
Melbourne, Victoria	The Observatory.
	University Library.
	Public Library.
Mexico	Central Meteorological Observatory.
Milan	Royal Astronomical Observatory.
Munich	Royal Observatory.
	Royal Bavarian Academy of Sciences.
	Geographical Society.
	The Publishers of the *Deutsche Rundschau für Geographie und Statistik*.
Nagpur	Chief Commissioner, Central Provinces.
	Sanitary Commissioner Ditto.
	Inspector General of Education, Central Provinces.
	Superintendent, Meteorological Observatory.
	Conservator of Forests, Central Provinces.
Naini Tal	Ditto ditto North-Western Provinces and Oudh.
New Haven, Connecticut	Connecticut Academy of Arts and Sciences.
	Editors of the *American Journal of Science*.
New York, U. S.	Central Park Observatory.
Nowgong-Rajshahye	Sub-Divisional Officer.
Ootacamund	Conservator of Forests, Government of Madras.
	Editor of the *South of India Observer*.
Oxford	Radcliffe Library.
	Radcliffe Observatory.
Paris	Observatoire Physique Central de Montsouris.
	Editor of *La Nature*.
	Physical Observatory, Meudon.
	Bureau Central Météorologique.
	Meteorological Society of France.
Perpignan, France	Commission Météorol. des Pyrénées Orientales.
Perth, W. Australia	Surveyor General.
Pesaro, Italy	Royal Observatory.
Philadelphia	Franklin Institute.
Poona	Conservator of Forests, Bombay, Northern Division.
Prag, Bohemia	Observatory.
Raipur	Civil Surgeon of Raipur.
Rangoon	Chief Commissioner, British Burma.
	Sanitary Commissioner, ditto.
	Conservator of Forests, ditto.
	Editor of the *Rangoon Times*.
Rome	Meteorological Office (Ministry of Agriculture).

List of Recipients of the Publications of the Meteorological Office—concluded.

Rio de Janeiro	Imperial Observatory.
Shaharunpore	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Chief Commissioner of Assam.
	Deputy Conservator of Forests, Assam.
Simla	Assistant Quarter-Master General, Intelligence Branch.
Singapore	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byran.
St. Petersburg	Observatoire Physique Central.
	Geographical Society of Russia.
Strasburg	Imperial University Library.
Stonyhurst	Stonyhurst College Observatory.
Sydney	Observatory.
	University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokei, Japan	Imperial Mining Office.
	Imperial Meteorological Observatory.
Toronto, Canada	Magnetical and Meteorological Observatory.
Turin	Royal Astronomical Observatory.
Upsala	Meteorological Observatory.
Utrecht	Royal Dutch Meteorological Institute.
Vienna	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus
	K. K. Geologische Reichsanstalt.
	Imperial Academy of Sciences.
	Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
Washington, U. S.	Chief Signal Officer, United States Army.
	Smithsonian Institution.
	Naval Observatory.
	Hydrographic Office.
	Professor Cleveland Abbe, Signal Office.
	United States' Geological Survey.
Wellington, New Zealand	Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Institute.

APPENDIX M.

Presentations to the Library from the 1st April 1883 to the 31st March 1884.

Place.	Donors.	Title of Work.
ADELAIDE	Meteorological Observatory	Meteorological observations made at the Adelaide Observatory during the year 1880.
ALGIERS	Meteorological Service	Bulletin Météorologique du Gouvernement général de l'Algerie; from 1st March 1883 to 10th January 1884.
		Résumé climatologique, June to September 1882.
		Tableau récapitulatif des quantités de plaie tombées quotidiennement; June to September 1882.
		Observations météorologiques du Réseau Africain, Année 1880; stations Algeriennes.
ALLAHABAD	Meteorological Office	Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1882-83.
		Sketch of the Meteorology of the year 1882 in the North-Western Provinces and Oudh and Eastern Rajputana.
AMSTERDAM	Royal Academy of Sciences	Proces-sen Verbaal, 1881-82.
		Jaarboek, 1881.
		Verslagen en Mededeelingen. Afd Natuurkunde. Tweede Reeks, Deel XVII.
BATAVIA	Magnetical and Meteorological Observatory.	Rainfall in the East Indian Archipelago, 1882 (fourth year).
BERLIN	Royal Prussian Statistical Bureau.	Der Südlichste Gletscher Europa's.
		Kurze Anleitung zur Anstellung der einfachster klimatologischen Beobachtungen.
		Klima des Brocken.
		Ueber den jährlichen Gang der Temperatur in Norddeutschland.
		Zur Leistungsfähigkeit des compensirten Magnetometers Weber Kohlrausch.
	Royal Meteorological Institute	Preussische Statistik LXXI: Ergebenisse der meteorologischen Beobachtungen im Jahre 1882.
BRUSSELS	Royal Academy of Sciences	Bulletins de l'académie Royal des sciences des lettres et des Beaux-arts de Belgique, 3me serie, Tomes I to V.
		Annuaire 1882 et 1883.
BOMBAY	Government of Bombay	Bombay Gazetteer, Vols. VII, XI, XII (Parts I and II), XIV, XV (Parts I and II), and XVI.
		Nineteenth Annual Report of the Sanitary Commissioner to the Government of Bombay for 1882.
		Report on the Enteric Fever.
	Meteorological Office	Brief Sketch of the Meteorology of the Bombay Presidency in 1882.
CALCUTTA	Comptroller General	Civil Estimates for 1883-84.
		Civil Account Code, Volume I, 3rd edition.
	Geological Survey of India	Records of the Geological Survey of India, Volume XVI, Parts II, III, and IV, and Volume XVII, Part I.
		Memoirs of the Geological Survey of India, Volumes XII, XIX (Part IV) and XX (Parts I and II).
	Government of Bengal	Report on the external trade of Bengal with Nepal, Sikkim, and Bhutan, for the year 1882-83.
		Returns of the rail-borne traffic of Bengal, during the quarters ending 30th June and 30th September 1883.
		Report on the internal trade of Bengal for 1882-83.
	Government of India Home Department.	Daily Bulletin of Synoptic Indications, and Forecasts for September to December 1877, issued by the Chief Signal Officer, Washington.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place	Donors.	Title of Work.
CALCUTTA—*contd.*	Government of India, Home Department—*contd.*	Rain and dry winds computed for different geographical districts, corrected to 1st January 1880 and 1st January 1881; issued by the Chief Signal Office, Washington.
		Suggestions as to the practical uses of meteorological reports and weather, maps; issued by the Chief Signal Office, Washington.
		Instructions for the management of self-recording meteorological instruments at the office of the Chief Signal Office, United States, America; issued by the Chief Signal Office, Washington.
		Instructions for taking and recording meteorological observations and for preserving and repairing instruments; issued by the Chief Signal Office, Washington.
		The influence of forests upon rainfall and inundations, being an extract from a work entitled "Etudes sur les Inondations," issued by the Chief Signal Office, Washington.
		Chronometer rates as affected by change of temperature and other causes; issued by the Chief Signal Office, Washington.
		Instructions concerning meteorological observations; issued by the Chief Signal Office, Washington.
		List of publications and maps relating to Forest Administration in India, sent to the Edinburgh International Forestry Exhibition of 1884.
	Government of India, Revenue and Agricultural Department.	Codes of the Financial Department, sixth edition, 1884.
		Statistics of the British-born subjects recorded at the Census of India, 17th February 1881.
		Statistics of the population enumerated in the Andamans, 17th February 1881.
		Report on measurements of the growth of Australian trees on the Nilgiris.
		Report of the Census of the Punjab taken on the 17th February 1881, Vols. I to III.
		Report of the Census of Assam for 1881.
		Note on Census operations in Central India and Statements showing population, &c., 1882.
		Census of North Western Provinces and Oudh in 1881, sex statistics.
		Census of the Central Provinces, 1881, Vols. I and II.
		Operations and results of the Census of 1881 in the Presidency of Bombay, including Sind.
		Report of the Census of the Baroda Territories 1881.
		Tables to accompany the rainfall map of the North-Western Provinces and Oudh, 1883.
		Administration Report upon the Madras Observatory for 1882.
		Operations and results of the Imperial Census of 1881 in the Presidency of Madras, Vols. I to V.
		Report of the Census of Bengal, 1881, Vols. I to III.
		The Indian Empire Census of 1881, statistics of population, Vol. II.
		Report on the condition and proceedings of the Government Observatory, Colaba, for the year which ended with the 30th June 1883.
	Inspector General of Forests with the Government of India.	Suggestions regarding Forest Administration in the Hyderabad Assigned Districts.
		Suggestions regarding Forest Administration in the Central Provinces.
		Review of the Forest Administration in the several Provinces under the Government of India, for the year 1881-82.
	Sanitary Commissioner with the Government of India.	Nineteenth Annual Report of the Sanitary Commissioner with the Government of India for 1882.
	S. R. Elson, Esquire . . .	The Sandheads Sailing Directory.
	St. Xavier's College Observatory	Meteorological observations recorded at the St. Xavier's College Observatory from January to December 1883.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place.	Donors.	Title of Work.
CALCUTTA—*contd.*	Surveyor General of India	General Report on the operations of the Survey of India during 1881-82.
CAPE OF GOOD HOPE	Meteorological Commission	Report of the Meteorological Commission for the year 1882.
CAPODIMONTE	A. Nobile	Terza determinazione della latitudine geografica del R. osservatorio di Capodimonte.
CHEMNITZ	Royal Meteorological Institute	Jahrbuch des Königl Sachs Meteorologischen Instituts, 1883. *Erste* Lieferung.
CHRISTIANIA	Professor Mohn	The Norwegian North Atlantic Expedition, 1876-1878 (Meteorology)
	Royal University of Norway	Jahrbuch des Norwegischen meteorologischen Instituts 1877 to 1880. Etude sur les mouvements de l'atmosphère, deuxiéme partie.
COLOMBO	Surveyor General of Ceylon	The Meteorology of Ceylon in 1881.
COPENHAGEN	Institut Météorologique Danois	Bulletin Météorologique du Nord, February 1883 to January 1884.
		Annuaire Météorologique pour l'annee 1881.
	Royal Danish Academy of Sciences	Oversigt, No. 3 of 1882 and Nos. 1 and 2 of 1883.
CORDOBA	Meteorological Office	Annales de la oficina meteorológica Argentina, Tomo III.
DEHRA DUN	The Editors	The Indian Forester, Volume X, Nos. 1 to 3.
	Trigonometrical Survey of India	Synopsis of the results of the operations of the Great Trigonometrical Survey of India, Vols. XIV to XVI.
		Account of the operations of the Great Trigonometrical Survey of India, Vols. I and IX.
GREENWICH	Royal Observatory	Greenwich magnetical and meteorological observations, 1881.
GUILFORD (SURREY).	A. H. Swinton, Esq.	Data obtained from solar physics and earthquake commotions applied to elucidate locust multiplication and migration.
HAMBURGH	Deutsche Seewarte	Monatliche Uebersicht der Witterung, September 1882 to August 1883 and year 1882.
		Wetterbericht, Nos. 32 *to* 365 of 1883 and Nos. 1 to 60 of 1884.
HONGKONG	Government of Hongkong	Meteorological observations recorded at Hongkong from February to December 1883.
		Meteorological observations recorded at stations in the colony of Hongkong for 1st to 14th December 1883.
IOWA	Weather Service	First and Second Annual Reports for 1876 and 1877.
KARLSRUHE	Baden Meteorological Observatory.	XIV Jahresbericht der Grossherz-Badischen meteorologischen Centralstation Karlsruhe für das Jahre, 1882.
KEW	G. M. Whipple, Esq., B.Sc.	Composite portraiture adapted to the reduction of meteorological and other similar observations.
	Kew Committee of the Royal Society.	Report of the Kew Committee for the year ending 31st October 1883.
LONDON	Balfour Stewart, Esq.	Terrestrial Magnetism.
	G. J. Symons, Esq.	Symons's Monthly Meteorological Magazine, March 1883 to February 1884
	Hon'ble Ralph Abercrombie, F.M.S., and William Marriott, F.M.S.	Popular Weather Prognostics.
	Institution of Civil Engineers	The Introduction of Irrigation into new countries as illustrated in North-Eastern Colorado.. .. ...O'Meara.
		Discharge of streams in relation to rainfall in New South Wales.
	Meteorological Society	Quarterly Journal, Vol. IX, Nos. 45 to 48.
		The Meteorological Record, Nos. 8 to 10.
		Instructions for the observation of phenological phenomena.
	Meteorological Office	Weekly weather report, Vol. VI, Nos. 49 to 52.
		Report of the Meteorological Council to the Royal Society for the year ending 31st March 1882.
		Weather Reports, 1st January to 30th June 1882; 1st July to 31st December 1882; 1st January to 30th June 1883.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place.	Donors.	Title of Work.
LONDON—*contd.*	Meteorological Office—*contd.*	The Quarterly weather report, Part II, April to June 1876, 1877, 1879, 1880, Appendices and Plates.
		Hourly readings from the self-recording instruments at the seven observatories, Parts I to IV, January to December 1881; Part I, January to March 1882.
		Rainfall tables of the British Isles for 1866 to 1880.
		Note on the Report on the Meteorology of Kerguelen Island, published by the Meteorological Council, 1879.
		Meteorologische Beobachtungen, angestellt auf Schiffen der Russischen Flotte, Band I.
		Meteorological Atlas of the British Isles.
		Sunshine records of the United Kingdom for 1881.
		Report of the second meeting of the International Meteorological Committee held at Copenhagen, August 1882.
	Royal Asiatic Society	Journal, Vol. XV, Parts I to IV.
	Royal Society	Proceedings Nos. 222 to 226.
	Society of Arts	Journal Nos. 1582 to 1633.
	Solar Physics Committee	Report by the Committee on Solar Physics.
	W. Clement Ley	Note on a proposed scheme for observation of the upper clouds.
MAGDEBURG	Meteorological Observatory	Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung Station 1er Ordnung. Jahrg I (1881 und 1882).
MANCHESTER	Rev. F. W. Stow, M.A., F.M.S.	Comparative observations of solar radiation.
		Solar radiation. An account of some experiments made at Herpenden, Herts.
		Solar radiation, 1869 to 1874.
		Absorption of the sun's heat-rays by the vapour of the atmosphere.
MANILA	Observatorio Meteorologico del Ateneo Municipal de Manila	Observaciones verificadas, October to December 1879, and also for 1880, 1881, and 1882.
MELBOURNE	Government Observatory	Monthly record of results of observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne observatory from March 1882 to November 1883.
MEUDON (Paris)	Physical Observatory	Annuaire du Bureau des Longitudes, 1884.
MEXICO	Central Meteorological Observatory	Anales del ministerio de Fomento de la Mexicana, Tomo VII.
		Boletin del ministerio de Fomento, Tomo VIII, Nos. 8 to 156.
		Revista mensual climatologica, Tomo I, No. 15; Tomo II, Nos. 1 and 2.
		Anuario, Ano de 1884 (Ano IV).
MILAN	R. Osservatorio di Brera in Milano	Osservazioni meteorologische orarie ottenute da strumente registratori durante l'anno, 1881.
		Sui temporali osservati nell'Italio superiore durante l'anno, 1878.
MONTSOURIS (Paris)	Observatoire de Montsouris	Annuaire pour l'an 1883.
MUNICH	Geographical Society	Jahresberichte, 1875 to 1881.
	Ludwig Radlkofer	Ueber die Methoden in der botanischen Systematik, insbesondere die anatomische Methode.
	The Publishers	Deutsche Rundschau für Geographie und Statistik, V Jahrg Nos. 7-12, VI Jahrg Nos. 1-6.
	Royal Academy of Sciences	Sitzungsberichte der Mathematische Physikalischen Classe 1881, Heft IV; 1882, Hefte I to V; 1883, Hefte I and II.
		Gedächtnissrede auf Otto Hesse.
		Abhandlungen der mathematische, physikalischen Classe, Band XIV. Abth II, III.
	Royal Observatory	Meteorologische und Magnetische Beobachtungen, Jahrgänge, 1881, 1882.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place.	Donors.	Title of Work.
MAURITIUS	Meteorological Society of Mauritius	Mauritius meteorological results for 1876.
MADRAS	Government of Madras	Manuals of the Salem district, Vols. I and II, and Kistna and Tanjore districts.
	Meteorological Office	Administration Report of the Meteorological Superintendent of the Government of Madras for 1882-83.
NAGPUR	Chief Commissioner, Central Provinces.	Report on the model farm in the Central Provinces for the year 1882-83.
		Report on the trade and resources of the Central Provinces for the year 1882-83.
NEW YORK	Meteorological Observatory	Abstract of registers from self-recording instruments, December 1882 to November 1883.
PARIS	Bureau Central Météorologique de France.	Bulletin International, Vol. XXVII, Nos. 61 to 365; Vol. XXVIII, Nos. 1 to 52.
		Annales du Bureau Central Météorologique de France, 1877; 1879, Tomes II and III; 1880, Tomes I and IV.
	Société Météorologique de France	Annuaire de la Société Météorologique de France, 1880, 4th Trimestre; 1881, 1st and 2nd Trimestre; 1882, January, February, and May to November; 1883, January to September.
PHILADELPHIA	Franklin Institute	Journal, March 1883 to February 1884.
PRAG	K. K. Sternwarte	Astronomische magnetische und meteorologische Beobachtungen im Jahre, 1882.
RIO DI JANEIRO	Imperial Observatory	Bulletin Astronomique et météorologique, January to October 1883.
		Annales de l'observatoire Impérial de Rio de Janeiro, Tome I: description de l'observatoire.
SINGAPORE	Principal Civil Medical Officer, Straits Settlements.	Annual Medical Report on the Civil Hospitals in the Straits Settlements for the year 1882.
		Straits Settlements meteorological returns for 1882.
STONYHURST	Stonyhurst College Observatory	Results of meteorological and magnetical observations, 1860, 1862, 1865 to 1870, and 1872 to 1882.
STOCKHOLM	Avee Panchee	Sur la variation diurne de la force du vent par H. E. Hamburgh.
ST. PETERSBURG	International Polar Commission	Communications from the International Polar Commission, Part IV.
	Physical Central Observatory	Annalen des physicalischen Central Observatoriums, Jahrg. 1881, Theil II.
SYDNEY	Government Observatory	Results of rain and river observations made in New South Wales during 1882.
		Results of meteorological observations made in New South Wales during 1875.
		The Sydney Observatory, its history and progress.
		Anniversary address delivered to the Royal Society of New South Wales on the 3rd May 1882, by H. C. Russell, B.A., F.R.A.S.,&c.
		The spectrum and appearance of the recent comet, H. C. Russell.
SYRACUSE	Osservatorio Centrale di Siracusa	Osservazioni meteorologichi, Anno VII, Nos. 1 to 12.
TASMANIA	Royal Society	Papers and proceedings of the Royal Society of Tasmania for 1882.
TIFLIS	Physical Observatory	Magnetische Beobachtungen des Tiflischer physicalischen Observatoriums im Jahre 1882.
TOKIO	Imperial Meteorological Observatory.	Meteorological observations recorded at Ozaka, Hiroshima, Nagata, and Nagasaki for July to December 1882; at Kobi, April, and August to December 1882; at Kanazawa, March, April, and September to December 1882; at Tokio, June to October 1882.
	University of Tokio	Measurement of the force of gravity at Sappro (Yesso), being an Appendix to Memoir No. 5 of the Science Department.
TORONTO	Meteorological Office, Canada	Report of the Meteorological Service of the dominion of Canada for 1881.
		Monthly Weather Review, February 1883 to January 1884.
		General Meteorological Register for the year 1883.
TURIN	R. Osservatorio Astronomico di Torino.	Bolletino dell'osservatorio della regia Universita di Torino (Parte meteorologica) Anno XVII (1882).

Presentations to the Library from the 1st April 1883 to the 31st March 1884—continued.

Place.	Donors.	Title of Work.
Upsala	Meteorological Observatory	Bulletin Mensuel, Vol. XIV, Année 1882.
		Sur la trombe du 7 Juin 1882 dans la vallée de Säby.
		Samlung of bemärkelsedagar tecken, marken, ordsprak och Strock ror ande vaderleken.
		Sur la distribution des Eléments météorologiques autour des minima et des maxima barométriques.
	Mons. A. G. Hogbom	Marche des isothermes en automne dans de Nord d'Europe.
	Dr. J. Hann	Zeitschrift der oesterr. Meteor. Gesellschaft Band XVIII, April to December 1883; Band XIX, January to March 1884; Index for 1883.
		Bericht über die Fortschritte der geographischen Meteorologie.
	Dr. Josef M. Pernter	Psychrometerstudie.
	K. K. Central Anstalt für Meteorologie und Erdmagnetismus.	Jahrbüch, neue Folge, XVI Band, Jahrg 1879; XVII Band, Jahrg 1880; XVIII Band, Jahrg 1881. Erster Theil.
		Telegraphischer Wetterbericht, Jahrg VII, Nos. 60-355, and VIII, Nos. 1 to 41.
	K. K. Geologische Reichsanstalt	Verhandlungen No. 5 of 1881; Nos. 12 to 18 of 1882; Nos. 1 to 9 of 1883.
Vienna		*Ginzel.*—Astronomische Untersuchungen über Finsternisse.
		Freih v. Haerdtt.—Bahnbestimmung des Planeten "Adria."
		Hammerl.—Über Regenbogen, gebildet durch Flüssigkeiten von verschiedenen Brechungsexponenten. Studie über das Kupfervoltameter.
		Happerger.—Bahnbestimmung des Kometen 1874, III (Coggia).
		Holetschek.—Uber die Bahn des Planeten 111 Até II Theil.
		Gruss und Kogler.—Über die Bahn der Oenone 215.
		Tschermak.—Über die Meteoriten von Mocs.
		Trans Wähner.—Das Erdbeben von Agram am 9th November 1880.
		Oppolzer.—Beitrag zur Ermittlung der Reduction auf den unendlichkleinen Schwingsbogen:
		Note über eine von Archilochos erwähnte Sonnenfinsterniss.
		Norbert Herz.—Zur Theorie der Bahnbestimmung eines Kometen:
		Über die Möglichkeit einer mehrfachen Bahnbestimmung ans drei geocentrischen Beobachtungen.
		Heinrich Krentz.—Über die Bahn des Kometen von 1771.
	Royal Academy of Sciences	*Karl Telbr.*—Über die Bahn der Kometarischen Nebelmasse Schmidt, 1882.
		Hobtschek.—Bahnbestimmung des vierten Kometen vom Jahre, 1874
		Stefan Wolyncewics.—Bahnbestimmung des Planeten 210 "Isabella.
		Richard Canaval.—Das Erdbeben von Gmünd am 5 November 1881.
		Ferdinand Antow.—Bestimmung der Bahn des Planeten 114 Cassandra.
		Tulner Preston.—Eine dynamische Erklärung der Gravitation:
		Über die Möglichkeit, vergangene Wechsel im Universum durch die Wirkung der jetzt thätigen Naturgesetze auch in Übereinstimmung mit der Existenz eines Wärmegleichgewichtes in vergrössertem Masstabe zu erklären.
		Mach.—Versuche und Bemerkungen über das Blitzableitersystem das Herrn Melsenes.
		Pernter.—Psychrometerstudie.
		Schwarz.—Astronomische Untersuchung über eine von Archilochus und eine in einer assyrischen Inschrift erwähnte Sonnenfinsterniss.
		Leisnar.—Zur Theorie des Lamontschen Variations. Apparates für Horizontal Intensitat.
		Gerst.—Methode zur Bahnbestimmung aus drei vollständigen Beobachtungen.

Presentations to the Library from the 1st April 1883 to the 31st March 1884—concluded.

Place.	Donors.	Title of Work.
VIENNA—*contd.*	Royal Academy of Sciences.	*Wolfbauer.*—Die chemische Zusammensetzung des Wassers der Donau von Wien im Jahre 1878.
		Foullon.—Über die mineralogische und chemische Zusammensetzung des am 16th February 1883. bei Alfianello gefallenen Meteorsteines.
		Tschermak.—Beitrag zur Classification der Meteoriten.
		Hann.—Über die Klimatischen Verhältnisse von Bosnien und der Herzegowina.
		Neissl.—Bahnbestimmung des grossen Meteores vom 13, Marz 1883.
		Norbert Herz und Issef Strobel.—Reduction des Anwer'schen Fundamental. Cataloges auf die Leverrier'schen Praecessionscoefficienten.
		Ferdinand Antow.—Definitive Bahnbestimmung und Ephemeriden für den Planaten 154 Bertha.
		Anzeiger. Nos. XVII to XXVIII of 1882; Nos. I to XXI of 1883.
VIZAGAPATAM	A. V. Nursingrow, Esq.	Results of Meteorological observations made at G. V. Juggarow's Observatory, Vizagapatam, during 1881 and 1882.
WASHINGTON	Chief Signal Office	Bulletin of International Meteorological Observations, 1st September to 31st December 1880.
		Monthly Weather Review, December 1882 and January 1883.
		Annual Report of the Chief Signal Office for the year 1880.
		Bulletin of International Meteorology for August 1882.
	United States Geological Survey	A new method of measuring heights by means of the barometer, by G. K. Gilbert.
	United States Naval Observatory	Meteorological observations made at the United States Naval Observatory during 1878 and 1879.
WELLINGTON	Meteorological Observatory	Abstract of meteorological observations, New Zealand, for the quarters ending September and December 1882, and March, June, and September 1883.
		Statistics of New Zealand (meteorology), 1878 to 1882.
		Meteorological observations, Wellington, March and April 1883.
WINDSOR (N. S. WALES).	John Tebbutt, Esq.	Results of meteorological observations made at the private observatory of J. Tebbutt at Windsor (New South Wales) in 1877-81.
ZI-KA-WEI	Magnetical and Meteorological Observatory.	Meteorological observations recorded at Zi-ka-wei, October 1882 to June 1883.
		Variations de l'aiguille aimantée pendant les Eclipses de lune. Régime des vents à Zi-ka-wei, 1877 to 1882.
ZURICH	Swiss Meteorological Institute	Meteorologische Beobachtungen an 16 stationen der Sweiz, January to December 1883.

Purchases for the Library.

Airy's Algebraical and Numerical Theory of errors of observations and the combination of observations.
American Journal of Science, March 1883 to February 1884.
Annalen der Physik und Chemie, Nos. 4 to 12 of 1883; Nos. 1 to 3 of 1884.
Barlow's Tables of squares, cubes, square roots, cube roots, and reciprocals of all numbers up to 10,000.
Brown's mechanical movements.
Comptes Rendus de l'Académie des Sciences, Tome XC, No. 2; Tome XCVI, Nos. 10 to 26; Tome XCVII, Nos. 1 to 27; Tome XCVIII, Nos. 1 to 8; Tables for Tomes XCV and XCVI.
Die Geometrischen Instrumente der gesammten praktischen Geometrie, deren Theorie Beschreibung und Gebrauch.
Elementary Meteorology; Scott.
Encyclopædia Britannica, volumes X to XV.
La Nature, Nos. 467, 469, 494, 503 and 511 to 562.
Merriman's Method of Least Squares.
"Nature," Nos. 662, 681, 686, 687 and 698 to 749.
Philosophical Magazine for March 1883 to February 1884.
Report of the British Association for the advancement of science for 1878 and 1882.

Government of India Central Printing Office.—No. 17 Meteor.—20-9-84.—400.

REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1884-85.

IN the Administration Report of the Meteorological Department for the year 1879-80, I gave a general summary of its work during the five years that had elapsed since its formation. The theme of this retrospect was mainly the re-organisation of the department, the measures taken to reform the pre-existing machinery of observation, to extend and complete it where most defective, and to render the results reducible to common standards; admitting, therefore, of their being compared with each other, whether relating to the same or any future or past year. The utilization of the information thus obtained, the publication of the current weather statistics, the endeavour to interpret these statistics by the light of general physical laws, and to apply the resulting knowledge to the prevision of the weather, had scarcely acquired the relative importance which it has since attained, and which is increasing in each successive year.

Another five years have now passed by, and I shall preface my report on the administration of the department for the year 1884-85, with a general review of the progress achieved in this, the second lustrum of its existence. In a slightly modified form, this review has already been submitted to the Right Hon'ble the Secretary of State, somewhat in anticipation of the completion of the full period.

GENERAL REVIEW OF THE OPERATIONS OF THE FIVE YEARS 1880-85.

The work of the department naturally falls into two divisions,—that of observation, and that of discussion and publication; the first dealing with the collection of the raw material of science, the second with its elaboration and its application to useful ends. It will be convenient, therefore, in giving an account of the progress of the last five years, to observe this order of treatment. Under the first heading I shall include not

only meteorological observation, strictly so called, but also such other registration of physical phenomena as has been carried on by the observational staff of the department.

1.—Observatories and Registration of Physical Phenomena.

(*a*) *Observatories.*—According to the purpose they are especially intended to subserve, the existing observatories may be classified as—

Low-level observatories in India.
Hill observatories „ „
Himalayan valley observatories.
Extra-Indian observatories.
Ships.

Of the first four classes, there were 117 observatories in 1880. There are now 128, contributing registers to the central or local offices, exclusive of 22 observatories in Bengal, which have been established in connection with the provincial system of telegraphic weather report. In respect of the kind and amount of work, they are of four classes, *viz.*—

1st class observatories, provided with instruments registering autographically. Of these there now three completely equipped, *viz.*, Calcutta, Bombay, and the Maharaja's observatory at Jeypore. A fourth will be established at Allahabad as soon as the building now in hand is completed, and a fifth, at Lahore, when the requisite instruments shall have been obtained from America. Jeypore is the only addition made to this class during the last five years.

2nd class observatories; at which, either hourly observations are made on four days in each month, or six-hourly observations daily. They are 26 in number; five more than in 1880; and, of these, 15 are furnished with instruments for the autographic registration of the wind direction and movement.

3rd class observatories, at which observations of the barometer, thermometer, wind, &c., are recorded twice daily, and maximum and minimum thermometers, rainfall, &c., once. Of these there are 95. There were 91 in 1880.

4th class observatories, at which only temperature, wind direction and rainfall are registered. These are 5 in number; 2 more than in 1880.

Of the whole number of 128 observatories, 12 are attached to various public offices, and independent of the department, and 6 are either private or foreign. The number of paid observatories under the department is 111. The following is a complete list, showing the classes to which they respectively belong:—

Bengal and Assam.

	Class.		Class.		Class.
Sibsagar,	2nd.	Purneah,	3rd.	False Point,	3rd.
Dhubri,	„	Durbhunga,	„	Calcutta (Alipore),	1st.
Bankipore (Patna),	„	Gya,	„	Do. (Chowringhee)	4th.
Hazaribagh,	„	Berhampore,	„	Demagiri,	„
Saugor Island,	„	Burdwan,	„	Mongpoo,	„
Cuttack,	„	Jessore,	„	Tura,	„
Chittagong,	„	Dacca,	„	Pedong,	3rd
Darjeeling,	3rd.	Silchar,			

North-Western Provinces and Oudh.

	Class.		Class.		Class.
Allahabad,	2nd.	Mussooree (Surveyor Gen-		Gorakhpur,	3rd.
Agra,	,,	eral's Office),	3rd.	Ghazipur,	,,
Lucknow,	,,	Dehra (Surveyor General's		Benares,	,,
Roorkee,	,,	Office),	,,	Jhansi,	,,
Chakrata,	3rd.	Do. (Forest school),	4th.	Pithoragarh,	,,
Ranikhet,	,,	Bareilly,	3rd.		
Mussooree (St. Fidelis),	,,	Meerut,	,,		

Punjab.

Lahore,	2nd.	Murree,	3rd.	Kailang,	3rd.
Mooltan,	3rd.	Sialkot,	,,	Delhi,	,,
Dera Ismail Khan,	,,	Ludhiana,	,,	Sirsa,	,,
Peshawar,	,,	Chamba,	,,		
Rawalpindi,	,,	Simla,	,,		

Central Provinces.

Nagpur,	2nd.	Hoshangabad	3rd.	Sironcha,	3rd.
Jubbulpore,	,,	Seoni,	,,	Raipur,	,,
Pachmarhi,	,,	Khandwa,	,,	Sambalpur,	,,
Saugor,	3rd.	Chanda,	,,		

Berar.

Akola,	3rd.	Chikalda,	3rd.	Makhla,	4th.
Buldana,	,,	Amraoti,	,,		

Central India and Rajputana.

Jeypore,	1st.	Indore,	3rd.	Sambhar,	3rd.
Sutna,	3rd.	Mount Abu,	,,	Bickaneer,	,,
Nowgong,	,,	Pachpadra,	,,		
Neemuch,	,,	Ajmere,	,,		

Bombay.

Colaba (Bombay),	1st.	Jacobabad,	3rd.	Surat	3rd.
Belgaum,	2nd.	Hyderadad (Sind),	,,	Malegaon,	,,
Poona,	,,	Bhuj,	,,	Ratnagiri,	,,
Deesa,	,,	Rajkot,	,,	Karwar,	,,
Kurrachee,	,,	Sholapur,	,,		

Madras.

Vizagapatam,	2nd.	Cuddapah,	3rd.	Cochin,	3rd.
Bellary,	,,	Madras,	,,	Wellington,	,,
Trichinopoly,	,,	Bangalore,	,,	Mercara,	,,
Gopalpur,	3rd.	Negapatam,	,,	Mangalore,	,,
Masulipatam,	,,	Salem,	,,	Rajahmundry	,,
Secunderabad,	,,	Coimbatore,	,,		
Kurnool,	,,	Madura,	,,		

British Burma.

Rangoon,	2nd.	Akyab,	3rd.	Toungoo,	3rd.
Bassein,	3rd.	Thyetmyo,	,,	Moulmein,	,,
Diamond Island,	,,	Mergui,	,,		

Bay Islands.

Class.		Class.	
Port Blair,	3rd.	Nancowry,	3rd.

Extra-Indian.

Class.		Class.		Class.	
Leh,	2nd.	Bushire,	3rd.	Katmandu,	3rd.
Aden,	,,	Quetta,	,,	Amini Divi (Lakhadives),	,,

The large majority of the observatories are situated on the plains or low table-lands of India. The obvious purpose of these is to furnish information of the state of the atmosphere over the length and breadth of the land. The hill observatories are those situated on the hill ridges or small plateaux, and by comparison of their registers with those of some neighbouring station at a low level, they show the variation of the atmosphere in a vertical direction. The present observatories of this class are the same as in 1880, except that the Ootacamund observatory has been relinquished, while an additional observatory has been established at Pithoragarh in Kumaon.

With one exception, the observatories in valleys in the interior of the Himalaya are of more recent date, and their object is different. There is reason to believe that, while the condition of the atmosphere over the mountain range is frequently very different from that which obtains over the plains, being cold and dense, when the latter is dry and hot, or frequently disturbed by storms while the latter is in a state of continued drought, the latter is to a considerable extent dependent on the former. It is with a view to the continued study of these relations, and also for obtaining information respecting the condition of the snows, that these Himalayan observatories have been established. They are at present three in number, *viz.*, Leh in the Indus valley, Kailang in the Chandra valley, and Chamba in that of the Ravi.

The observatories of Bushire, Aden, Zanzibar,[1] and the Seychelles have been established for the purpose of affording some information of the state of the atmosphere, more especially as regards pressure and winds at a few points, distant from India itself, but not so distant that the atmospheric conditions there prevailing may not have considerable influence on the Indian weather, and especially on the varying characters of the monsoons. The full utility of this class of observatories can hardly be brought out, until we possess a much better knowledge, than at present, of the average meteorological conditions of the North Indian Ocean. Three of the above observatories, *viz.*, Aden, Zanzibar, and the Seychelles, have been established during the past five years, and the information they afford is supplemented by that of the monthly abstracts communicated by Mr. Meldrum from the Mauritius.

(*b*) *Marine observation.*—The endeavour to collect information from ships by the direct agency of the department has hitherto been restricted to the Bay of Bengal. In 1881, Mr. Eliot organised a system of collecting from ships entering the port of Calcutta, copies of so much of the meteorological entries in their logs as related to their passage up the Bay of Bengal from the Equator. In the first year, 345 sets of these returns were obtained and posted in books according to their dates. In the second year the number was smaller, *viz.*, 253, but of higher quality, and as the result of the two years' experience, Mr. Eliot is of opinion that a large amount of valuable information can easily

[1] As will be recounted later on, both these observations ceased to furnish registers in 1884.

be obtained from the captains of vessels navigating the Bay, and that the majority of the officers of the mercantile marine are ready, even at considerable trouble to fill in the returns, in the hope that they may be of some use in the investigations of the Meteorological Department.

In addition to the data thus obtained from merchant vessels, regular meteorological registers are now kept on board the light vessels near the mouth of the Hooghly.

(*c*) *Rainfall registration.*—In 1880 there were two extensive tracts in British India, from which rainfall returns were almost entirely wanting. One of these comprised Western Rajputana, Khyrpore, and Bahawalpur, an area of about 65,000 square miles between the Aravali range and the Indus. The other, the greater part of Chutia Nagpur, South Rewah, the Gurhjat States, and the zemindaries that lie between Nagpur and the Northern Circars. The total extent of this latter region is about 150,000 square miles. Rain-gauges have now been established at 7 stations in the former, and 26 stations in the latter. A few of these were in existence in 1880, although the registers were not available in the office, but the majority have been provided within the last five years. At the present time, rainfall returns are received regularly from all parts of the empire.

It has long been an object to obtain a form of gauge suitable for collecting the rainfall in forests and places at a distance from any habitation; which, therefore, can only be visited at more or less distant intervals. Elaborate mechanical contrivances for registering the fall are but little fitted for use in a country where skilled mechanics are so rare, and it has therefore been sought to attain the object by using a capacious receiver, and by providing a separate apparatus for measuring the evaporation. This contrivance, as hitherto tried, has not been found to give very accurate results in the hot season, when rain occurs at long intervals and the evaporation is rapid, but the experiments are still being carried on, and I have little doubt that success will be achieved before long.

(*d*) *Actinometric observation.*—The measurement of the sun's heat has received much attention during the last five years. In November 1879, registration with a Balfour Stewart's actinometer was commenced at Alipore Observatory, and continued daily till February 1883, when the observations ceased, the instrument being required at Mussooree. The results are not without interest, and Professor G. Stokes detected in them an apparent variation, which seemed to indicate a slight increase of solar intensity, too systematic to be the result of accidental circumstances: but the experience gained showed that the skies of Calcutta are far from favourable for such work.

Meanwhile, Sergeant Rowland, of the Royal Engineers, had been appointed by the Secretary of State to proceed as actinometric observer to Leh, a station which the almost uniform testimony of residents had indicated as one presenting peculiar advantages for actinometric observation. He arrived at Bombay on the 31st October 1882, and was employed during the following eleven months at Mussooree, practising his work and verifying his instruments under the direction of Mr. J. B. N. Hennessey. He reached Leh in the beginning of November 1883, together with an European assistant, who had been trained with him; and, during the past year and a half, has registered observations according to an admirably devised scheme, drawn up by Mr. Hennessey. But the climate has proved most disappointing. Not only has the work been so frequently interrupted by cloud that, in some months, it has not been possible to register a single day's complete set of observations, but even, when unclouded, there has been a peculiar haze, indicated by

the pallor of the sky, which is almost certainly absorbent of an appreciable portion of the solar heat. Whether this is the same haze to which the brilliant afterglows and frequent coronas of the past year are due, and therefore an abnormal feature of the Leh climate, can be only a matter of speculation.

As there is some reason to believe that the year has been exceptionally unfavourable,[1] the observers will remain at Leh till October 1885. An opinion may then be formed whether the advantages presented by Leh over such a station as Mussooree are such as to justify the further retention of an observer at that station.

(*e*) *Sunshine Recorders.*—The registration of the duration of bright sunshine by means of the instrument originally invented by Mr. Campbell of Islay, and subsequently improved by Professor Stokes and Mr. Whipple, has been carried out at Calcutta since November 1882, at Allahabad since March 1882, and at Jeypore since January 1884, and will be shortly extended to Lahore, and some more central station, probably Nagpur. The duration of sunshine is of not less importance than its intensity, as a meteorological datum, and its registration is a most valuable addition to the records of Indian meteorology.

(*f*) *Records of ground temperature.*—The temperature of the ground at the surface, and at depths, varying down to 25 feet, is regularly recorded at Calcutta, Allahabad, Dehra, and Jeypore. It varies from year to year, and appears to depend partly on the amount of sunshine, the principal heating agent, partly on the cooling effect of evaporation; which again depends on the rainfall. In 1880, the only register of this kind was that of the Alipore Observatory, Calcutta. It was begun at Allahabad in May 1880, at Dehra in June 1881, and at Jeypore in August 1881.

(*g*) *Snowfall reports.*—Reports on the state of the Himalayan snowfall, during the winter and spring, were first received from the Commissioner of Kumaun in 1880, and occasional information has also been communicated by other officers; in 1882, at the request of the Government of India, the attention of Civil Officers residing in the Hill States was especially directed to the subject: further steps were taken to the same end in 1883; and in the winters of 1883-84 and 1884-85, and the following springs, monthly reports were regularly received from all parts of the Himalaya, in which there are resident Civil Officers, as well as much casual information collected from travellers by these officers, or communicated by non-official residents.

The importance of this information lies in the apparent connection between the Himalayan snows and the dry winds of North-Western and Western India,—a subject to which I shall return in a subsequent part of this report.

[1] In a foot-note to the Administration Report for 1882-83, I quoted from a Report of the Surveyor-General, General J. T. Walker, as follows :—"I believe from much experience of the climate, that few better places in the world can be found than Leh for any sun observation. The number of cloudy days in the year is very small. One may say that from early April to October there are almost none. The air is perfectly free from moisture, and without vapour of any kind, &c." In conjunction with this, I may give the following extract from a letter dated 3rd November 1884, recently received from the Revd. A. W. Heyde, resident for some 30 years at Kailang in Lahoul, 10,000 feet above the sea. "I think I have mentioned it already in former letters to you that, since about 12 to 15 years, the latter half of August the whole of September and October have become very unsettled as regards the weather, rain or snow occurring now, often during these months, which, as a rule, formerly was a time of fine clear weather. These untimely precipitations interfere very unpleasantly with the hay-making and harvesting in the valley now nearly every year, of which many complaints are heard. Whether this has something to do with a change of climate, which, as is said, is gradually coming over these parts, I cannot say. A similar experience is made in Ladak and other parts of the Western Himalaya. Officers who took part in the triangulation of Ladak, during four or five seasons between 1860 and 1870, say they never could have done their work, if, at that time, the sky over Ladak had always been so cloudy and the high ranges so frequently been enveloped in clouds as is now the case."

(*h*) *Seismic observatories.*—The registration of earthquakes has been undertaken at some observatories in Assam for the information of the Geological Survey. The apparatus, provided for the purpose by the Superintendent of the Geological Survey, has been set up at the observatories in the above province, with a view to convenient registration, and not because of any intimate connection being supposed between earthquakes and meteorology.

2.—Discussion and Publication.

The immediate object of the department, and indeed its justification in the eyes of the general public, is to disseminate trustworthy information of the current weather, and, as far as may be, to prognosticate that which may be expected to follow. It is in this direction that the chief advances have been made during the last five years.

The prevision of the weather indeed is at present *in embryo*, and must be so until the laws of weather changes are much better known than at present. But this knowledge is steadily advancing, and numerically weak as is the Indian Meteorological Department in its scientific staff, it may fairly challenge comparison with its representatives in other countries, in the importance of its contribution to the general stock. I will first notice the extensions of the weather report systems that have been effected in recent years, and will afterwards advert on the scientific work of the officers and its bearing on weather prevision.

(*a*) *Daily weather reports for India.*—The daily telegraphic report of the weather was started in 1878, and in 1880, reports were received from 50 stations in the fine season, and from 84 in the rains, of which 24 reported only the rainfall. During five months of the rains, the weather bulletins were issued at Simla, and were then accompanied with a short verbal description of the weather, in addition to the tabulated returns for the day. During the remainder of the year they were published in Calcutta and consisted of the tabulated data only.

In 1881 the system was extended. All observatories with which there is telegraphic communication, (at present 96 in number) now send a daily telegram of the weather throughout the year; and, in the rains, these reports are supplemented by telegrams of the rainfall only from 28 additional stations, making 124 in all. Also the information given is fuller, including the highest and lowest temperatures of the previous 24 hours, in addition to other information.

The report is issued with a descriptive summary of the state of the weather throughout the year, and this is telegraphed every afternoon to all the seats of Government and to the principal daily newspapers. A daily chart is prepared for office use, but this is not published.

(*b*) *Daily and weekly weather reports for Bengal.*—Two weather bulletins are issued daily from the Bengal Office from the 15th May to the 15th November, and one during the remainder of the year. That which is issued only during the south-west monsoon, gives the weather of the province as telegraphed every morning from 31 observatories, of which 22 are maintained at the cost of the Government of Bengal. A report on these is prepared daily, printed with the tabulated data at the Bengal Secretariat Press, and distributed the same afternoon, in time for the outgoing mails. This system was organised by Mr. Eliot in May 1883, and has now been in work during two seasons with great success.

The report, issued daily throughout the year, gives the weather around the coasts of the Bay of Bengal, and, inferentially that of the Bay itself, on the information reported by telegram daily from 17 stations at 10 A.M. In April 1880, the number of telegraphing stations was increased from 7 to 15, and the report was for the first time lithographed, illustrated by a rough chart, and printed in the Meteorological Office, and circulated to subscribers the same afternoon. Since then, this issue has been much improved in form, and is now equal in appearance to the average of similar publications issued by European Governments. The general improvement, effected in this report and in its expeditious publication, has been proposed and carried out by Mr. Eliot in the last five years. In addition to the above, weekly meteorological and rainfall statements are prepared and published in the *Calcutta Gazette*. The first gives the average and extreme values of all the meteorological elements for the week, at all the observatories in the province, and the second gives the daily rainfall at 166 stations. They are accompanied with a descriptive summary.

A similar, but more comprehensive, summary is drawn up and issued monthly.

Thus, a system of provincial weather report has been established in Bengal on a semi-independent basis, and is worked with great despatch, and in a most effective manner. The observatories of the imperial system are utilized as far as they go, but they have been largely added to; the weather telegrams are transmitted as urgent, and therefore have priority of despatch, and the reports relating to any day are printed and distributed on the afternoon of that day. All the additional expense incurred for the purpose is contributed by the Local Government. These improvements have been introduced and carried out by Mr. Eliot within the last two years.

(*c*) *Storm warnings in Calcutta and Bombay.*—A system of storm signals, for warning the port of Calcutta of cyclones approaching from the Bay, has been in operation since 1868, and was indeed the object for which the Bengal Meteorological Department was originally founded. As will presently be explained more at length, the study of these storms has always engaged much of the attention of the officers who have successively held the appointment of Meteorological Reporter to the Government of Bengal; and Mr. Eliot, especially, has contributed several valuable memoirs on them to the publications of the department. As the result of these studies, Mr. Eliot found himself enabled, in November 1881, to propose to the Government of Bengal a considerable extension of the system then existing, which had aimed merely at giving warning to Calcutta of the formation and approach of those extensive and severe storms; which are, as a rule, restricted to the periods of the changing monsoons. These occur but rarely, and in some years fail entirely; but storms of limited extent, which nevertheless are frequently very violent over a small area, are commonly formed at the head of the Bay during the rainy season, and indeed may be considered as a characteristic feature of the season. They are dangerous to shipping leaving the port of Calcutta, and it was therefore desirable to have the means of issuing special warnings to the lower reaches of the river, whenever such storms appear about the Sand Heads. The new system of signals devised by Mr. Eliot was especially adapted to give this information, and, in certain cases, to indicate the probable course the storm would take; whether to east or west of the mouth of the Hooghly.

After due consideration, the new system was approved by the Government of Bengal and its adoption was notified in the *Calcutta Gazette* on the 9th August 1882. It has since been working with excellent results.

A system of telegraphic report and storm warnings for the coasts of Bombay was established in 1880. Storms are rarer on the Bombay coast than on the Indian coast of the Bay of Bengal, and comparatively little attention has been paid to the laws of their formation and their courses. It was however known that, in some cases, storms, originating on the Bay of Bengal, cross the peninsula, and affect the ports on the west coast; and hence, in organizing a system of telegraphic weather report for warning the Bombay coasts, it was necessary to provide for due notice of storms, occurring on the east coast of India, being communicated to the Bombay Office. The scheme eventually adopted, and which has been in operation for the last five years, provides for daily weather telegrams being sent to Bombay from three stations on the Madras coast, as well as from eight on the west coast of India; and the Bombay reporter is empowered, on occasion arising, to call for urgent reports from other observatories in the interior of the country. Furthermore a special notice is telegraphed from the Meteorological Office of the Government of India, of any storm that appears in any part of India, and which seems likely in its subsequent course to affect any part of the Bombay coast. Storm signals, consisting of a cone for the daytime and three lamps in a triangle at night, are provided at Bombay and five other ports, and are hoisted on due intimation to that effect from the Bombay Office.

(*d*) *Flood warnings.*—This is an object, towards which, at present, some first steps only have been taken; and it remains for future experience to show how far useful warnings are practicable. The only occasion on which anything of the kind has been attempted hitherto, was one in which an irrigation officer, engaged in the construction of a weir across the Betwa river, desired to have early information of the setting-in of the monsoon rains at India. It has been recently proposed, as a consequence of the destructive floods of the Nerbudda and Tapti, to communicate to the Civil Officers and Political Officers of Surat, Baroda, &c., early notice of any unusually heavy rainfall in the drainage basins of these rivers, and a plan has been drawn out which will be brought into operation as an experiment on the approach of the next rainy season.

The floods in these rivers are usually the result of the excessive rainfall accompanying the passage of a cyclonic storm, (one of the small monsoon storms adverted to above,) which, as a general rule, originate over the head of the Bay of Bengal, and then travel westwards. As they generally take two or three days to reach Central India, it is almost always possible to send ample premonitory notice of their approach to the hilly region in which the floods originate, even if it be found impracticable to send notice of the actual rain, in time to anticipate the flood. As far as practicable, however, this last will also be attempted, but the information will be telegraphed direct from the rainfall stations to those threatened by the flood, and not sent through any Meteorological Office.

If this system be found to give useful information, it might be extended to some other rivers. Its applicability is however restricted by the consideration, that many of the large rivers rise in hilly and thinly populated districts, where neither rainfall measurements nor telegraphs are available.

(*e*) *Weather forecasts.*—Any successful forecast of the weather that can pretend to be more than a happy guess, fortuitously fulfilled must be the last outcome of a highly developed body of science; and nothing could be more unreasonable than to expect from a system of observation, which has not yet existed for ten years, more than a few imperfectly verified generalizations, which may perhaps hereafter be developed into the

basis of a trustworthy system of weather prognosis. Some such generalizations have indeed been elicited from the systematic study of the weather, and will presently be noticed. Actual forecasting has hitherto been attempted only, firstly, in the case of the Bengal daily weather reports, issued during the monsoon, in which the probable weather of the ensuing 24 hours is depicted briefly in the most general terms; and, secondly, in the case of the monsoon rains, with respect to which, in one or two years, an endeavour has been made to estimate the probabilities of the monsoon, from a consideration of the weather of the antecedent period. Such partial success as has attended these attempts to forecast the weather seems to testify to the general validity of the method adopted, and to justify the hope that further experience may enable them to be repeated with increased confidence.

(*f*) *Time Signals, Calcutta.*—Although but remotely connected with meteorological work, the working of the Time-signals may be mentioned here as part of the work of the department, undertaken for public information and guidance. The old time-ball on the Semaphore Tower in Fort William was replaced by a new ball and apparatus, (the invention of Mr. Varley,) in 1882, and a similar apparatus, set up the previous year on the Port Commissioners' Office, was worked during the removal of the old ball, and the erection of its substitute. Both balls have been dropped daily, (except on Sundays and holidays,) since May 1882. New and shorter connections have been made between them and the Alipore Observatory; and, during the last year, the time signals have been worked with a degree of regularity never before attained in Calcutta.

(*g*) *Publication.*—The regular publications of the office, other than the ephemeral weather reports and returns, consist of the Annual Report on the meteorology of India; the original registers, in full, of six stations in India; and the serial issue of special discussions, under the title of the *Indian Meteorological Memoirs*. The first appears yearly, the second monthly, the third at irregular intervals.

Of the memoirs, nine had been published up to 1880. The following have since appeared:—

VOLUME I, PART V	.	*10th.*—Some results of meteorological observations at Allahabad during the 10 years 1870-79. By S. A. Hill, B.Sc. *11th.*—The diurnal variation of the barometer at Indian stations. Part II—Goalpara, Patna, and Leh. By H. F. Blanford.
„ VI	.	*12th.*—The meteorology of the North-Western Himalaya., By S. A Hill.—Index to Volume I.
„ II, „ I	.	*1st.*—Account of the South-West monsoon storms of the 18th to the 24th September 1878, in the north of the Bay of Bengal. By John Eliot, M.A. *2nd.*—List of cyclones on the west coast of India, and in the Arabian Sea, up to the end of the year 1881. By F. Chambers.
„ II	.	*3rd.*—Note on the foregoing list of cyclones and on the Guzerat land cyclone of July 11th—13th, 1881. By H. F. Blanford. *4th.*—On the temperature of North-Western India. By S. A Hill, B.Sc.
„ III	.	*5th.*—Account of the south-west monsoon storm of the 8th to the 19th October 1882, in the Bay of Bengal. By J. Eliot, M.A.

Another memoir on the storms of the years 1877 to 1881, by Mr. Eliot issued since the close of the year under report, and a memoir by Mr. Hill on certain comparative hygrometric observations at 4 feet and 40 feet above the ground, now in the Press, will complete volume II, and a discussion of the rainfall of India, now well advanced towards completion, together with the rainfall tables, will probably by itself make a third volume of the memoirs

Other publications of the office, that have been issued since 1880, are—A rainfall chart of India, on a scale of 64 miles to the inch, showing the average annual distribution of the rainfall according to locality and season; published in 1883. *Instructions to Meteorological Observers in India,* 2nd edition, enlarged and corrected. *Telegraphic Code and Instructions,* for use in the Indian Meteorological Department, 3rd edition, enlarged and revised, 1883.

(*h*) *General Scientific Results.*—I now come to speak of those general results which represent the solid gains of the last ten years' work, *viz.*, those advances in our general knowledge of the climatology and physical meteorology of India, which enable us, in the first place, to give some rational explanation of weather changes and the variations of the climate now in progress; and afford, in the second place, the only possible basis for a prognosis of those which are impending in the future. I do not here include mere statistics or descriptions of climate. These, indeed, are given abundantly in the regular publications of the office, and are doubtless useful for comparison with statistics of other kinds. But such are only the raw material for scientific treatment, and it is only when they are compared and examined by the light of physical laws that they lead up to any real extension of our knowledge.

Two subjects, more especially, have engaged the attention of the small scientific staff of the department, *viz.*, the mode of origin, and the progressive march of storms, and the laws which regulate the rainfall and its vicissitudes. The list of memoirs, given above, shows that one-half of those, published during the last five years, deal with the cyclones of India and its seas; and the much more comprehensive memoir of Mr. Eliot, lately issued, is devoted to the same subject. It has already been mentioned, in an earlier part of this memorandum, that as the result of the increased knowledge gained from the assiduous study of storms, a considerable extension and improvement of the storm-warning system has been carried out in Bengal; and it is this same knowledge that has enabled Mr. Eliot to give, during the rainy season, a general forecast of the weather of the day. The flood warnings which it is now proposed to issue to the districts near the mouths of the Nerbudda and Tapti rivers, and those warnings of approaching storms which, during the past two or three years, have been sent from the Central office to Bombay, generally two or three times in the season, are further fruits of the study of storm tracks.

The other subject, the rainfall and its vicissitudes, is one presenting much greater difficulties, and progress is consequently slow. Only two memoirs, *viz.*, the 5th and 7th of the 1st volume, are specially devoted to the subject of rainfall; but incidentally, it enters as a subject of discussion into several others, specially the first; and the third volume of the memoirs will be entirely devoted to it. The chart of the average rainfall of India, published in 1883, is one of the first fruits of this investigation. Certain coincidences and sequences have been observed in the very vicissitudes of the rainfall, which seem to be recurrent, and are probably capable of being generalized into laws. One of these is set forth in the 7th memoir of the 1st volume; and the other, having been frequently referred to in the annual reports, has recently been put into a definite form and published in the proceedings of the Royal Society. The first is the discovery of Messrs. Hill and Archibald, that copious winter rains in Northern India are usually followed by a deficient monsoon rainfall. The second is the apparent fact that extensive snow precipitation on

the North-West Himalaya tends to produce dry winds in North-Western and Western India; and hence, an unusually heavy and late spring snowfall causes a retarded or interrupted monsoon rainfall in those parts of India. At bottom, these appear to be statements of one and the same truth, approached from different directions. In the last two years, a forecast of the monsoon rainfall has been hazarded on this basis; and, in both instances, the results have so far justified the prognosis as very considerably to enhance my confidence in the soundness of the fundamental assumption.

The only great famine that has occurred in India, since the Meteorological Department was placed on its present basis, was the result of a prolonged drought, evidently partly induced by other conditions. These also have been placed on record, and their recurrence, at any future time, will serve as a presage of the possible recurrence of severe drought.

The question of the periodicity of rainfall variations and of other meteorological phenomena has engaged the attention of several officers of the department. In more than one case, such periodical variations, apparently coincident with the well-known sun-spot variation, have been detected; and it is possible that, to some extent, those conditions which manifest them most distinctly may influence the rainfall. But it cannot be said, at present, that this connexion rests on any stronger basis than a certain preponderance of probabilities; and, in any case, the periodical element of the rainfall variation, if real, is probably of subordinate importance, and only of local validity.

The study of the meteorology of Indian seas has been taken in hand systematically within the last three years, and will certainly become more important in the future. As yet, the work is not so far advanced as to admit of any generalizations of importance. And when the average conditions of Indian seas shall have been determined from the accumulated observations of past years, a considerable extension of the present system of marine registration will be necessary, in order that the knowledge, thus acquired, may be turned to account in throwing light on the current weather changes.

Weather charts of the Bay of Bengal, for each month of the year, are in part completed and will be lithographed and published for the use of seamen. Those showing the prevailing winds and the state of the barometer are completed in original, and they are now being copied and reduced to a convenient size for publication.

ADMINISTRATION IN 1884-85.

PART II.

INTRODUCTION.

IN the preceding pages, I have given a general summary of the progress and work of the department during the last five years. In the remarks which here follow, as prefatory to the special report on the administration of the past year, it will therefore be necessary only to add some further particulars relating to certain of the topics already noticed, and which have received more especially the attention of the scientific staff of the department in the year now under review.

ACTINOMETRIC OBSERVATIONS.—In the reports of the two previous years, I have detailed the steps taken to give effect to a recommendation of the Commissioners appointed, by the Secretary of State, to report on the famine of 1876—1877, in so far as related to the systematic registration of the solar heat with the best and most suitable instrument hitherto constructed. It has been related that Sergeant Rowland of the Royal Engineers, together with an European assistant, selected and trained at the Surveyor General's Office at Dehra and Mussooree, was sent to Leh in the autumn of 1883, and that the observers commenced their work in November of the same year on a site selected by them on arrival, as affording the best exposure for the purpose. According to the scheme of operations drawn up for their guidance by Mr. Hennessey, the observations to be recorded were of two classes, a more and a less comprehensive series of observations of the solar heat; the solar rays being concentrated, by means of a lens, on the blackened bulb of a thermometer, surrounded by a massive brass box. On all clear days, these observations were to be taken at noon, (with the sun on the meridian), and also once in the morning and once in the afternoon, with the sun at certain definite altitudes. These were the daily series.

In addition to these, on certain selected days, (from 1 to 6 in each month), similar observations were to be taken at short intervals in succession, during so many hours as the altitude of the sun should exceed a certain assigned minimum. These were termed long range series, and it was anticipated that, under the clear skies to be expected at Leh, a very large series of observations of the solar intensity would be thus recorded, on a systematic plan, at a place where unfavourable and disturbing atmospheric conditions would interfere but little with its completeness and continuity, and where the observers would be above the level of the denser and more absorbent atmospheric strata.

These hopes have been doomed to disappointment. Owing to the cloudiness of the skies, Leh has proved, during a large part of the year, even less favourable for the work, than the station of Mussooree, at which the observers were trained previously to their departure; and instead of the approximately complete series expected, the following are all that the observers have been able to obtain during the 17 months of their residence at Leh.

Months.	Daily Series.		Long Series.	
	Complete.	Incomplete.	Complete.	Incomplete
November 1883	...	1	...	...
December „	3	3	...	...
January 1884	3	2	...	1
February „	2	3	...	3
March „	1	3	...	3
April „	1	5	...	1
May „	...	6	...	...
June „	6	4	1	...
July „	5	2	...	1
August „	4	6	1	2
September „	8	6	2	...
October „	3	0	...	2
November „	6	5	...	...
December „	4	...	...	...
January 1885	...	2	...	...
February „	3	2	1	1
March „	3	3	1	...
Total	52	64	6	14

Fifty-two complete sets of daily observations and six long series, together with 64 imperfect sets of the former and 14 of the latter, are therefore the total result of seventeen months' work. The question naturally presents itself how the capabilities of Leh, as an observing station for actinometric work, should have been so greatly over-estimated when the scheme was originally planned. The station was selected on the unanimous testimony of the most experienced officers; one of whom, Dr. Cayley, was for some years a resident at Leh, and another, General Walker, based his opinion on the reports of the Survey officers who were engaged for several years in the Survey of Ladak, and whose work gave them peculiar advantages for correctly estimating the clearness of the atmosphere. With the single exception of Mr. deNiceville, who, at the meeting of the Asiatic Society in February 1883, expressed a doubt whether the atmosphere would not be obscured by dust, the testimony was uniformly in favour of the selection; and the single objection raised by Mr. deNiceville has not been found valid on experience. The only

explanation that can be offered is that, there appears to have been really a change in the prevailing atmospheric conditions of Ladakh during the last few years. This opinion has been distinctly expressed by the Revd. A. W. Heyde, in connection with another subject; and his experience as a resident in the North-Western Himalaya for 30 years past, in conjunction with the fact that Mr. Heyde is a man of careful observant habit, entitles his opinion to very considerable weight. Both General Walker's and Mr. Heyde's remarks have been quoted in the foot-note at page 6 of this report and need not here be reproduced.

Sergeant Rowland and his assistant Mr. Shaw will return to India at the close of the present season, leaving Leh in time to ensure their reaching the passes before they shall be obstructed by the early winter snows.

SUNSHINE RECORDS.—The automatic registration of the duration of sunshine, which was carried on at Calcutta and Allahabad in the previous year, was commenced at the Maharajah's observatory, Jeypore, in January 1884, and instruments have been ordered from England for the purpose of extending it to some other stations. The instrument, used for this purpose, is a glass sphere, mounted in such a manner that the sun's rays, falling upon it, are focussed on a strip of card-board held in a ring-shaped support. This retains the card at the focal distance from the spherical lens; and between the sun's rising and setting, the path traced by the focus along the card strip burns its own record, being of course interrupted during such time as the sun is obscured. The cards are printed with the proper graduation in hours, so that the hours of the sun's obscuration can be at once read off. The durations of sunshine and cloud are important, not only as an element of climate in relation to health and agriculture, but also as a datum for physical meteorology; since it indicates the time during which the solar heat is being extended on the earth and lower atmospheric strata, and on the higher and cloud-forming strata respectively.

FIRST CLASS OBSERVATORIES.—The provision of proper buildings for the proposed first class observatories at Lahore and Allahabad, which has been in abeyance for nearly ten years, has at length been partially and will shortly be wholly effected. In April 1884, I visited Lahore while on a short tour of inspection in the Punjab, and on learning that a small building in the neighbourhood of the jail, the property of Government, would soon be vacated, I visited it and found that the site was as suitable for the establishment of an observatory as could reasonably be expected in the immediate neighbourhood of a provincial capital. Application was accordingly made to the Punjab Government for the reversion of the building and granted; and the Observatory and Meteorological Reporter's Office were moved into it on the 1st January 1885.

In the meantime, the meteorograph, originally intended for Lahore, having been disposed of to the Maharajah of Jeypore, for the excellent observatory established at his capital, steps were taken to provide self-recording instruments to replace it. It has not been thought desirable to obtain another meteorograph, as, in the circumstances of the Lahore observatory, something much simpler and demanding less experience in the use of delicate mechanism and practical physics, would be more suitable. Such appear to be the instruments devised by Dr. Draper and in use for some years at the New York observatory. Mr. Hill, the Meteorological Reporter to the Government of the North-Western Provinces and Oudh, being on a tour in America in 1883, visited this observatory and reported in favour of the instruments, which he found to work satisfactorily and to be very

much simpler in their mechanism than the beautiful meteorograph of Van Rysselberghe. Accordingly a set has been ordered for the Lahore observatory, and meanwhile, pending their receipt, the work of the observatory will be carried on in the same manner as hitherto.

The Allahabad observatory is now in course of erection on the site selected for it in the Chatham lines, as announced in my report for last year. Meanwhile, thermometric and hygrometric observations have been carried on, simultaneously, at the new and old observatories, since September 1884; with a view to ascertaining the difference, if any, in the normal values of the two sites, and thus determining the corrections that must be applied to the registers of past years, to render them comparable with those of the new observatory. These show that the change of site will introduce an appreciable change into the normal values of radiation, temperature, and humidity; and since the characteristic features of each year are only usefully estimated as departures from those normal values, they afford further evidence how important it is to any sound system of meteorological registration, never to introduce changes of site or method that can be avoided; and, in the event of such change being unavoidable, how necessary it is to ascertain by comparative observations, sufficiently prolonged, the amount of the resulting change at different seasons of the year. In the case of tropical observatories, this is probably even more important than under the duller skies of the temperate zone. The meteorograph intended for the observatory is now in Calcutta.

NATIVE ASSISTANT.—Hitherto, all the officers of the department have been Europeans, who have either received a special education in science, or have been trained in the technical work of a meteorological office. During the past year, it was resolved, as an experiment, to endeavour to train an educated native to undertake the preparation of the daily weather reports and thus set free the Assistant Reporter Mr. Dallas, who has hitherto been engaged on this work, for the performance of administrative duties. After some enquiry from the heads of the principal colleges of the Upper Provinces, Lalla Ruch Ram Sahni, a native of the Punjab, who had taken his B.A. degree in Physical Science, and has since passed the examination for the M.A. degree, was selected for the post of native assistant, and since January has been engaged in learning the special work of the department. So far his progress has proved very satisfactory, and there is reason to believe that with some further experience he may be entrusted with this part of the daily work.

The experiment is of some special interest, as the employment of natives in purely scientific work, as distinguished from the practice of scientific arts (medicine, surgery, and engineering), is comparatively new; the only previous attempt of a similar character, as far I am aware, being the employment of native assistants on the Geological Survey of India. Lalla Ruchi Ram Sahni has shown much intelligence and aptitude, and promises to become a useful addition to the scientific staff of the department.

RAINFALL STATISTICS.—Some further additions have been made to the stations that send in regular monthly returns of the rainfall to the Central Office, from parts of the country that have as yet been inadequately represented. The most important of these are eight new stations in Rajputana, chiefly in Western Rajputana, a region which a few years ago presented a blank on our rainfall charts. For these I am indebted to the exertion of Dr. Hendley, the Residency Surgeon of Jeypore, who had previously reformed

and virtually re-established the excellant observatory founded and supported by the Maharajah of the State. The newly established rain-gauge stations are—

Kerowlee.	Barmer.
Didwana.	Jasol.
Nagar.	Pali.
Phalodi.	Sirohee.

The largest blanks, now remaining, are the region north of Bickaneer and the Native States of Bahawalpore and Khyrpore.

Since the publication of the chart of the average rainfall of India, drawn up in 1882, and published in 1883, charts have been prepared, on a smaller scale, showing the average rainfall of the three chief Indian seasons, *viz.*, the monsoon (June to October), the cold weather (November to February), and the spring (March to May). Several copies of these have been furnished to Government, and they have also been lithographed on a reduced scale for illustrating a memoir on the rainfall of India, now in part ready for the press. Charts of the rainfall of the corresponding seasons of the past year have also been prepared for Government; and the preparation of similar charts of each season of the current year will henceforth form a part of the regular routine of the department.

SNOWFALL REPORTS.—The system of monthly snowfall reports, established two years ago, has furnished very useful information, which has been utilized for attempting a farecast of the monsoon. The reports are of very various degrees of detail and merit: some being restricted to the mere perfunctory statement of some local snow measurement in the baldest style of official return, while others give evidence of careful enquiry and observation appreciatively conducted, the result being condensed in a concise and intelligent report. Among the best of these latter are those of the Assistant Commissioner of Kulu and the Deputy Conservator of Forests, Bushahir. For very excellent reports on the state of the snows of Lahoul, as well as for much other meteorological information, I am indebted to the Revd. A. W. Heyde, resident at Kailang.

FORECASTING THE MONSOON RAINS.—The experience of the last two years has tended strongly to confirm the idea, put forward originally in the report on the meteorology of India in 1876, that the Himalayan snowfall exercises a prejudicial influence on the monsoon rainfall of the plains. But much more experience is necessary, before it will be possible to say, with any confidence, what part of the country is most likely to be affected in any given season. In some years, the dry west or north-west winds, which blow during drought, are more prevalent in Western India and the Deccan; in others they seem rather to be restricted to the North-Western Provinces and Rajputana; and the only indication that we have, at present, to show in which of these alternative areas they are most likely to prevail in any season, is that afforded by their especial prodominance, in one region or the other, during the period immediately preceding the rainy season.

In the spring of 1884, the snows on the North-Western Himalaya were more extensive and later than they had been in any previous year since 1878; and in a memorandum, dated 7th June, the following attempt was made to forecast the prospects of the season:—

"I look for a somewhat retarded or weak and interrupted monsoon in the earlier months, in part or parts of North-Western India, extending possibly, but by no means necessarily, to the northern portion of the Bombay Presidency and Rajputana. This is the area that experience has shown to be most subject to the anomalous prevalence of dry westerly

winds in the monsoon, as it is that of their normal prevalence in the spring. But it is not likely that the whole of this area will be simultaneously affected, and it is equally unlikely that the conditions, now existing, will operate through the whole of the monsoon. In many respects, the present season resembles the first part of 1876."

The result, as stated in the monthly weather summaries for June, July, and August, was as follows:—"On the 19th June, rain became pretty general throughout the country; the only exceptions being portions of Bundelkhand and the North-Western Provinces, Sind, and Central India. On the 22nd, however, the rainfall on the west coast was checked, and the break spread gradually from the west coast to a very large part of India. Towards the close of the month, precipitation was slight in most places, and had entirely ceased in Guzerat, Central India, Rajputana, and on the plains of the Punjab, and the North-Western Provinces. Rain continued, however, in the Central Provinces and Bengal, and . . . the rainfall of these two provinces was slightly in excess of the average." "In July, . . . over the greater part of the plains of the Punjab, as well as in Rajputana, Sind, and Guzerat, rain of any consequence was almost entirely wanting during the first fortnight; as was also the case in some parts of the Carnatic, in Madura, Mysore, the ceded districts of the Madras Presidency, and the Deccan. By the 16th, however, a change set in. Rain-bearing winds spread suddenly over Guzerat and subsequently extended to Rajputana and the Punjab. From the 20th to the end of the month, the rains were general and abundant, with the exception of the Madras Presidency." "In August, in the Punjab, except at Rawalpindi, on the hills and at Delhi, there was more or less deficiency; but over nearly the whole of the North-West Provinces, there was excessive rain. From Allahabad eastward, however, in Behar, Bengal, and as far as Burma, the rainfall was generally deficient. Rajputana, like the Punjab, had a somewhat scanty rainfall. On the west coast, from Ratnagiri southwards, the fall was above the average, but both on the coast north of Ratnagiri and at almost every peninsular station to the east of the Ghats, the amount of rain was below the average of the month.'

"In September, the rainfall was abundant in Northern India, except in Behar, Northern Bengal, and Assam; but in the peninsula it was still deficient in the Deccan, Mysore, and the Carnatic."

Hence it may be asserted that the predicted retardation or interruption of the rains of the early part of the monsoon of North-Western India was fully justified by the event. After a general burst in the latter part of June, the rains of all Western and North-Western India were entirely suspended for three weeks or more, and even up to August they were somewhat defective in the Punjab. But the conditions, there existing, did not operate through the whole of the monsoon, and the latter months brought abundant rain.

Nothing was said in the forecast respecting the deficiency of the Bengal rainfall in the latter part of the season, nor of that of the Deccan, Bellary, Mysore and the Carnatic, nor at present are the conditions that brought about that deficiency at all well understood. These are subjects for future enquiry.

FLOOD WARNINGS, BOMBAY.—On the 26th July 1884, heavy floods occurred in the Rivers Tapti and Nerbudda, which resulted in the submergence of a portion of the city of Surat; and these were followed, on the 31st, by the flooding of the Subarmati, Mahi, and neighbouring rivers which discharge into the Gulf of Cambay, causing serious breaching of the Bombay and Baroda Railway. Again, on the 3rd September, the same rivers were

in flood, with the like disastrous consequences. All these floods, and also a flood which occurred in September 1882, were the consequence of small cyclones of the south-west monsoon type, which either travelled to Western India from Bengal or the Central Provinces, or, in the last instance, had travelled up the west coast at the end of August.

Shortly after the last occurrence, it was proposed by Mr. Pearson, the Officiating Reporter for Western India, to extend the Bombay storm warning system, with a view to giving notice to the Civil Officers of such districts in Guzerat and Khandesh as are particularly exposed to floods, and to add Rajkot, Mount Abu, and Chikalda to the list of stations sending daily telegrams to Bombay, at a cost of ₹2,500.

On the report being referred to this office by the Government of Bombay, it appeared that the object in view might be achieved in a more satisfactory manner, without additional expense, by utilising the existing Imperial system of telegraphic report. It was pointed out that the storms, which had caused these disastrous floods, had been traced from their origin in the daily weather reports issued by the Simla Office, and that in all cases in which there appeared any possibility of their bringing stormy weather to the Bombay coast, their progress had been reported by urgent telegram to the Bombay Meteorological Office. Also, that it had been previously the practice of the office to telegraph or cause to be telegraphed to certain officers of the Irrigation Department who had desired it, the occurrence of heavy rain around the head waters of certain rivers in Central India, and that information of a similar character could, if desired, be communicated to the Civil Officers of Surat and other districts, that might be threatened with floods.

It was accordingly proposed that the Superintendents of the Observatories, situated near the head waters of the Tapti and Nerbudda, should be instructed that, in the event of the rainfall exceeding 3 inches in the 24 hours, an urgent telegram should be sent to such officers as the Bombay Government might name, and further, that premonitory warnings should be sent from the Simla Office, giving notice of the approach of a storm to the Central Provinces, Central India, and Guzerat.

These proposals having been approved by the Government of Bombay, the necessary steps were taken to give them effect, and already, during the present season, one such warning has been issued, although, as the event showed, all further consequences were averted, by an unexpected change in the path followed by the storm.

At the same time, the Meteorological Reporter for Western India has been requested to take up the question of these floods, and investigate the circumstances attending their origin, with a view to the greater efficiency of the system. This step had been proposed by Mr. Pearson, *proprio motu*, but as that gentleman vacated his appointment in November last, on Mr. F. Chambers' resuming charge of his own office, it remains for Mr. Chambers to carry it out.

THE LAWS OF STORMS.—A very important addition has been made, during the past year, by Mr. J. Eliot, Meteorological Reporter to the Government of Bengal, to his previous admirable work on this important subject. In previous reports, he has traced out in detail the history of several individual storms from their origin, and has thus, by comparative methods, arrived at several very important generalizations, which have placed our knowledge of the conditions of cyclone formation on a firm basis; an undertaking for which the geographical conditions of the Bay of Bengal offer peculiar advantages.

He has now treated the whole question of storm formation and storm tracks in a much more comprehensive manner. Taking as the basis of his work, the daily weather charts of India, which have been drawn up in the Meteorological Office since 1877, he has taken out the track of every storm generated over the Bay of Bengal, between the months of May and December, during the five years 1877—1881 (forty-six in all), and has discussed them, at such length as the available data admit of, in a memoir of 216 quarto pages, illustrated by 7 plates, which has been recently issued as Part IV of Volume II of the Indian Meteorological Memoirs. The following are some of the more important conclusions which Mr. Eliot has established as the result of the enquiry.

Cyclonic storms are a regular and frequent feature of the whole south-west monsoon period, and are of all degrees of intensity.

The prevalence of steady south-west winds, giving general rain over the land area of Northern India, for more than a few days, is an event of comparatively rare occurrence. The atmospheric action during the south-west monsoon is intermittent and oscillatory. A weakening of the monsoon current is usually accompanied by its retreat southward; during which interval, any rainfall is light and partial; and these breaks in the rains are each followed by a renewed advance of the monsoon, each advance being preceded by conditions similar to those which usher in the monsoon on its first establishment. The formation of a cyclonic storm is frequently the result of such advance.

Notwithstanding that the Bombay branch of the monsoon, where it crosses the coast, is nearly twice as strong as the Bengal branch at the head of the Bay, there is not a single instance of a storm from the Arabian Sea having crossed from west to east. On the other hand, numerous storms are recorded as having originated at the head of the Bay, and crossed completely the head of the peninsula from east to west, disappearing near or in the Arabian Sea.

The following has been the distribution of cyclonic storms during the five years 1877—1881, according to the three seasons, the change from the winter to the summer monsoon, the summer monsoon, and the change from the summer to the winter monsoon.

	1877.	1878.	1879.	1880.	1881.	TOTAL.
May	1	0	2	1	1	5
June to September	6	5	3	6	8	28
October to December 15th	1	4	4	2	2	13

It was formerly supposed that the majority of the storms occurred at the change of the monsoons. This is now shown to be erroneous. But the error is explained by the fact that, the storms of the transitional periods are more severe and destructive, and hence have been recorded as storms, while the less severe storms of the monsoon have escaped notice as such.

With respect to the course of the storms and the part of the coast affected by them, the following table shows their distribution in the eight months, May to December :—

Number of Cyclones during the five years 1877—1881.

Months.	Burmah coast.	Bengal coast.	Orissa coast.	Ganjam coast.	Circars coast.	Coromandel coast.
May	...	2	1	...	...	2
June	...	1	3	...	...	...
July	...	1	3	1	...	...
August	...	3	8	...	...	...
September	...	2	5	1	...	...
October	...	1	1	1	3	...
November	2	...	...	...	1	3
December	...	...	...	...	1	...

This shows that the intersection of the storm tracks and the coast advance and retreat with the monsoon, confirming the conclusion previously arrived at from the study of violent storms only, a list of which was published in 1877, in the Journal of the Asiatic Society of Bengal.

Cyclones of the transitional periods are of low elevation, the vortex being restricted to a moderate thickness of the lower atmospheric strata. Within this stratum, the barometric disturbance is much greater, and the winds more violent, than in the storms of the monsoon period; but after reaching the land, they are more readily broken up on meeting low hill ranges. Those of the monsoon are of great elevation, the barometric disturbance is slight, and the winds rarely of destructive violence, but the storms are more lasting and frequently cross the whole breadth of Northern India, being but little affected by the irregularities of the land.

MARINE METEOROLOGY.—Mr. Dallas has completed the set of monthly charts, showing the distribution of barometric pressure, the prevalent winds and marine currents of the Bay of Bengal; and the January chart has been lithographed on a reduced scale as a specimen of the work, and circulated to the Port officers, Marine Weather Institutes, and some ship commanders, for criticism, with a view to obtaining opinions on its utility and suggestions for improvement. Several replies have been received, and some valuable suggestions offered, among which I would especially notice the report of Dr. C. Neumayer, the Director of the German Seewarte at Hamburgh.

Having regard to these, some modifications will be made in the plan of the charts, the lithographing of which will now be proceeded with. Dr. Neumayer has suggested the

advantage of the several Marine Institutes assisting each other with the data at their disposal, and informs me that the German Institute can furnish a considerable quantity of material for some parts of the Bay of Bengal charts, for which those furnished by the London Meteorological Office are most deficient. It seems most desirable that this offer should be accepted, but I do not propose to defer the publication of the charts for this purpose, but would rather look forward to the issue of the revised and improved edition at some future date.

Meantime, the barometric, wind and current charts of the Arabian Sea are now being taken in hand, as I consider it of more importance to prepare and publish these at an early date, than to deal with the temperature data of the Bay of Bengal.

Up to the date of his departure on furlough, Mr. Eliot continued the collection of marine logs for the Bay of Bengal from vessels visiting the Port of Calcutta. One hundred and sixty-six returns were received during the year, the log-books being in many cases sent in by the captains spontaneously without special application, and in other cases, they have themselves called at the office with the extracts made by themselves. There is, therefore, a very cordial response on the part of officers of the mercantile marine to the invitation issued by Mr. Eliot, and that gentleman has made much use of the information collected, in the cyclone reports he has prepared and published in the Meteorological Memoirs.

PART III.

OBSERVATORIES.

AT the close of the official year 1883-84, there were 127 observatories contributing registers to the Central Office, as announced in the report for that year; exclusive of 22 which had been established in Bengal as a part of the provincial system. One of these, indeed, Mahé in the Seychelles, had not contributed any register since January 1884, and as none has been received since, it may be regarded as virtually non-existent. Another extra Indian observatory, Zanzibar, ceased to send registers in December 1884, owing to the death of the officer who had continued the meteorological observations, after the transfer of the agency to Her Majesty's Foreign Office. On the other hand, a new observatory has been established at Chamba in the North-West Himalayan hill-state of that name, and another at Rajahmundry in Madras. Instruments have also been lent to Father Desgodins, S.J., in charge of a missionary station at Pedong in British Bhutan, for the equipment of a small observatory at that station on the volunteer system. Thus 128 observatories were in existence on the 31st March 1884, as already stated in Part I of this report, and 129 contributed registers for the whole or a part of the year. A list of these, specifying the classes to which they severally belong, has been given at pages 2—4.

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character, and an important part of the work is the working of the time signals for the Port of Calcutta. It is immediately superintended by the

Reporter to the Government of India, and the establishment is under the immediate charge of the Chief Observer, Babu Brojo Mohun Rakhit, B.A. During the past year the work of the observatory has consisted of—

1st.—Continuous registration, by autographic instruments of (*a*) the duration of bright sunshine, (*b*) the atmospheric pressure, (*c*) temperature, (*d*) moisture (dry and wet bulb thermometers), (*e*) wind direction, movement and pressure, and (*f*) rainfall.

2nd.—Periodical readings, five times daily, of the barometer, dry and wet bulb thermometers, measurements of rain and estimates of cloud proportion, once daily of the maximum and minimum thermometers in shade, those of the exposed thermometers for nocturnal radiation and insolation, and thrice daily those of the ground thermometers at the surface, 1 foot, 3 feet, and once at 6 feet deep. Also occasional observations on the movements of the higher clouds by means of the nephescope.

3rd.—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporter for Western India, and the comparison of all barometers with the Calcutta standard.

4th.—The determination of the mean local time, by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port. Also the custody and rating of Government chronometers.

The establishment for the above purposes consists of—

Babu Brojo Mohun Rakhit, B.A.	Chief Observer.
,, Annoda Prosad Banerji, B.A.	1st Photo. Asst.
,, Ramchandra Chakravarty	2nd Ditto.
,, Mohindro Nath Banerji	Observer.
,, Shyam Lall Sen	Ditto.
2 Artificers.	
1 Batteryman.	
6 Servants.	

The autographic instruments consist of a sunshine recorder, the Kew barograph and thermograph, which register by photography, a Beckley's anemograph, an Osler's anemometer and a Beckley's rain-gauge. During the past year, with but slight exceptions, the instruments have worked well. There has been a great improvement in the working of the barograph and thermograph, owing to increased care on the part of the observatory establishment, and the interruptions of the photographic records have been much fewer than in any preceding year. The Beckley's anemograph by Adie, which had been in operation since the establishment of the observatory in 1877, was dismounted in November last and replaced by a new and improved instrument, on the same principle, constructed by Casella.

From the following comparative table of the readings of the standard barometer and the barograph traces, it appears that the values of the latter instrument underwent a sudden fall in March 1884 (*viz.*, on the 19th), which was due in all probability to a small bubble of air having penetrated the Torricellian vacuum. Since that date, the values seem to have remained practically constant, the average of the nine months, April to December, indicating a permanent depression of ·031 inch below those of the standard. This has been applied as a correction to the measurements of the traces from the date of the change.

Comparative mean reduced readings of barograph and standard barometer in 1884.

1884.	Standard Barometer.					Barograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January	30·053	30·129	29·996	30·070	30·062	30·044	30·127	29·995	30·068	30·059
February	29·966	·045	·903	29·983	29·974	29·959	·044	·901	29·982	29·972
March	·831	29·896	·758	·849	·834	·816	29·884	·744	·837	·820
April	·767	·821	·687	·774	·762	·738	·793	·658	·746	·734
May	·664	·707	·595	·675	·660	·632	·680	·564	·647	·631
June	·587	·626	·526	·609	·587	·554	·596	·492	·577	·555
July	·530	·569	·479	·555	·533	·492	·537	·442	·522	·498
August	·582	·626	·530	·616	·589	·543	·590	·491	·582	·552
September	·682	·734	·618	·710	·686	·645	·701	·582	·678	·652
October	·889	·942	·831	·897	·890	·859	·919	·803	·871	·863
November	·973	30·029	·911	·981	·974	·943	30·007	·886	·959	·940
December	30·071	·135	30·003	30·077	30·072	30·042	·110	·978	30·053	30·046
Year	29·800	29·855	29·736	29·816	29·802	29·772	29·832	29·711	29·794	29·778

The following table gives a comparison of the readings of the dry and wet bulb thermometers under the usual thermometer shed, with the measurements of the corresponding thermograph traces. The mean differences are almost exactly the same as in the year 1880, the first year in which a comparison was instituted. There is an apparent rise of 0·1° in the thermograph traces, which may well be due to a real rise of the zeros of the thermograph tubes. The original difference 0·3° may be due either to the same cause, or, as is equally probable, to a real difference of temperature under the open shed and under the thermograph pent-house.

Comparative mean readings of the Thermograph and Dry bulb Thermometer in the Thermometer Shed, in 1884.

1884.	Thermometer in shed.					Thermograph (Dry bulb).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	55·8	67·6	75·2	60·2	64·7	56·6	66·1	73·9	61·2	64·5
February	60·4	72·0	79·4	64·6	69·1	61·3	70·6	78·3	65·3	68·9
March	72·5	84·0	91·8	76·8	81·3	73·6	83·2	91·2	77·9	81·5
April	76·2	88·3	93·6	80·1	84·6	77·6	88·4	94·2	81·6	85·5
May	77·9	85·8	88·4	79·1	82·8	79·0	86·7	89·1	80·3	83·8
June	78·7	85·4	86·8	79·7	82·7	79·6	86·1	87·4	80·8	83·5
July	79·5	83·1	84·1	81·1	82·0	80·3	83·9	84·8	81·6	82·7
August	79·0	83·3	84·1	80·3	81·7	79·7	84·7	84·9	81·1	82·6
September	77·7	82·5	82·3	79·3	80·5	78·5	83·0	83·1	80·0	81·2
October	73·7	81·2	83·0	75·7	78·4	74·6	81·1	83·0	76·6	78·8
November	62·7	73·8	78·1	65·5	70·0	64·0	73·0	77·3	66·5	70·2
December	57·3	68·9	74·8	60·5	65·4	58·6	67·9	73·9	61·4	65·5
Year	71·6	70·7	83·5	73·6	76·9	72·0	79·6	83·4	74·5	77·4

Comparative mean readings of the thermograph and wet bulb thermometer in the Thermometer shed, in 1884.

1884.	Wet bulb in shed.					Thermograph (wet bulb).				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	54·4	60·5	61·8	57·9	58·7	54·3	59·7	61·5	58·3	58·5
February	58·7	63·8	63·8	61·3	61·9	59·0	63·1	63·8	62·4	62·1
March	70·8	72·9	70·7	72·5	71·7	71·5	73·5	72·4	73·4	72·7
April	74·2	76·6	75·8	75·8	75·6	74·9	77·4	77·3	76·6	76·6
May	75·8	79·0	79·0	75·9	77·4	76·6	79·7	80·0	76·6	78·2
June	77·2	80·2	80·1	77·3	78·7	77·7	80·9	80·9	77·9	79·4
July	78·3	79·6	79·9	79·0	79·2	78·6	80·1	80·3	79·3	79·6
August	77·9	79·2	79·5	78·2	78·7	78·3	79·9	80·5	78·7	79·4
September	76·7	78·3	78·0	77·5	77·6	76·9	78·7	78·6	77·8	78·0
October	72·4	74·1	74·4	73·8	73·7	73·0	74·6	75·0	74·3	74·2
November	60·4	65·1	65·6	63·0	63·5	60·9	64·8	65·8	63·6	63·8
December	55·7	61·5	62·3	58·5	59·5	56·0	61·2	62·4	58·8	59·6
Year	69·4	72·6	72·6	70·9	71·4	69·8	72·8	73·2	71·5	71·8

The sunshine recorder has worked satisfactorily and without interruption.

The observations of ground temperature at the surface, and at depths of 1 foot and 3 feet have been steadily continued, and an additional series was commenced in March 1884 with a thermometer at a depth of 6 feet. The series at 1 foot deep has been carried on with two thermometers, for the reasons stated, and in the manner described in the report for last year. The result of another year's comparative readings fully accords with that of the first year, as stated in the report for 1883-84. There is no doubt that the temperatures, shown by the old thermometer at 1 foot, were seriously affected by the connection of air in the wooden tube, resulting in a lowering of the night temperatures, which in certain months exceeded 1°. The comparison of the two instruments will however afford the means of correcting these erroneous registers, and thus they will eventually be made available for discussion. An abstract of the registers is given in the Report on the Meteorology of India for the year 1884.

The number of instruments verified at the Alipore observatory during the year ending 31st March 1885 is as follows :—

Instruments.	No.
Barometers	61
Aneroids	11
Dry and wet bulb thermometers	37
Maximum thermometers for air temperature	55
Minimum do. do.	28
Do. do. for nocturnal radiation	24
Solar radiation thermometers	5
Standard do.	14
Six's do.	1
Salinometers	6
TOTAL	242

and the following is a return of those received and issued by the Observatory Store Department:—

Instruments.	Received.	Issued.
Barometers	41	63
Aneroids	7	5
Dry and wet bulb thermometers	19	49
Maximum thermometers for air temperature	19	44
Minimum do. do.	21	32
Do. do. for nocturnal radiation	25	34
Solar radiation thermometers	6	38
Standard do.	2	7
Six's do.	0	1
Sling do.	0	3
Actinometers	0	3
Salinometers	6	6
Hypsometers	0	6
Anemoscopes	0	6
Pyrheliometer	0	1
TOTAL	146	298

Both receipts and issues are very considerably less than in the previous year, notwithstanding that the issues include a large number of instruments simply transferred to the Meteorological Office, and not issued to observatories; the corresponding return for 1883-84 having been swollen by the issues for the equipment of 22 provincial observatories in Bengal.

The time signals have continued to work in the same satisfactory manner as in the previous year. Two time balls are dropped from the Alipore observatory, the one on the Semaphore tower in Fort William, the other on the Port Commissioners' Office on the Strand. Both balls dropped correctly on 286 days. One failed on 1 day only, the other on two days. The remaining 76 days were Sundays or public holidays.

Table showing the occasions of failure of two time balls during the official year 1884-85.

Dates of failures.	Nature of failure.
25th April 1884	Time ball at the Port Commissioners' Office failed altogether.
23rd July „	Time ball on the Semaphore tower, Fort William, dropped a few seconds late.
10th March 1885	Time ball on the Semaphore tower, Fort William, dropped a few seconds late.

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—The twenty-three observatories, which have been established in Bengal for the purposes of the provincial system of daily weather report, are not at present included in the Imperial system. They are enumerated in the note below.[1] Excluding these, there are in Bengal and Assam 22 observatories in addition to that of Alipore.

[1] The observatories established for the system of daily local report in Bengal are the following:—

Balasore.
Midnapore.
Raneegunge.
Noakholly.
Burrisal.
Serajgunj.
Comillah.
Furreedpore.
Mymensingh.
Rampore Bauleah.
Dinagepore.
Rungpore.
Julpigoree.
Bhagalpur.
Chupra.
Motiharee.
Buxar.
Arrah.
Dehree.
Nya Doomka.
Ranchee.
Chybassa.
Bogra.

The list has already been given at page 2.

In Mr. Pedler's Report (Appendix A) are given the names of the superintendents and observers at all the second and third class stations and also at Demagiri and Tura. The Chowringhee observatory is attached to the Meteorological Office, the clerks of which record the observations; and Mongpoo and Pedong are included in the list of stations which report direct to the Central Office (Appendix E).

Mr. Pedler reports that two of the second class observatories, Hazaribagh and Cuttack, were visited by his head clerk; the former was found to be in fair, the latter in very satisfactory condition. The Dhubri observatory shed was burnt down in April 1884, and as, for unexplained reasons, it was not till November that it was reconstructed, only an inperfect register could be kept during the interval. The observer at this station, a very careful and trustworthy man, Muniruddin Ahmed, died while absent on sick leave, shortly before the reconstruction of the observatory was completed. Mr. Pedler reports that the rest of the second class observatories continued to furnish satisfactory returns throughout the year; but an exception must, I think, be made of Saugor Island, where the registers of one instrument were grossly erroneous throughout the year, owing to the observer's neglect of the official instructions. Of the third class observatories, three, *viz.*, Darjeeling, Durbhunga, and Jessore, were inspected by Mr. Eliot, and two, Gya and False Point, by the head clerk of the Bengal Office. At Darjeeling, the Casella's anemograph, which had entirely failed to give useful records, was replaced by the Beckley's anemograph, which had previously been in use at Alipore. This was set up in March, in an excellent position on the summit of Mount Vernon, (7,509 feet above the sea), and was at work just before the close of the year under report. This is an excellent observatory.

The Gya observatory has long been very unsatisfactory. I have had to reject the whole of the barometric registers of this station for 1884 as untrustworthy, and Mr. Pedler reports equally unfavourably on some other classes of observations. The observer has twice been under supension of his meteorological allowance during the past year. But Mr. Pedler reports that there has since been an improvement in his work.

The Jessore observatory was found to be in good order, but the position is a confined one. The Durbhunga observatory, which was unfavourably reported on last year, has much improved. The False Point observatory is highly spoken of, and also those of Berhampore and Burdwan. And, generally speaking, the returns from the third class stations were satisfactory.

The following observers have had special allowances allotted to them for the current year:—

Names.	Stations.	Amounts.
		₹
Makhadaprosad Chowdhry	Burdwan	10
Mahendronath Roy	Berhampore	10
Dandadhar Datta Barua	Sibsagar	10
W. H. Alley	Cuttack	5
Nathoo Lall	Hazaribagh	5
Romesh Chundra Buddra	Silchar	5
Poreshnath Raichowdhry	Jessore	5

OBSERVATORIES IN THE NORTH-WESTERN PROVINCES AND OUDH.—The seventeen observatories in these provinces have been enumerated on page 3. With the

omission of Pauri, they are the same as in the previous year. The names of the superintendents and observers are given in Appendix BII to Mr. Hill's Report.

The Allahabad observatory has continued on the footing of a second class observatory, but the building for a first class observatory to be established on the Chatham lines has been put in hand and is expected to be finished in November next.

Of the second class observatories, one only, *viz.* Agra, has been inspected during the year. The condition of the observatory was found to be satisfactory. The work of the Roorkee observer shows much improvement, and is now nearly equal to that of the best observers in the provinces. It is intended to reduce the existing second class observatories in the North-Western Provinces to the third class scale, as soon as the Allahabad observatory shall be in readiness to commence work as an observatory of the first class.

Of the third class observatories in the North-Western Provinces and Oudh, none have been visited during the year. Judged from the character of the registers sent in, they are working in a satisfactory manner.

The following observers have been granted special allowances for the year now current :—

Names.	Stations.	Amounts.
		R
Kadernath Chatterjee	Allahabad	10
Chotoy Lall	Lucknow	10
Jawa Nand	Ranikhet	10
Chiranji Lal	Roorkee	10
Mir Altaf Ali	Agra	5
Siligram	Chakrata	5
Devakinandan Pathak	Benares	5

OBSERVATORIES IN THE PUNJAB.—The number of observatories in the province has been increased to thirteen by the establishment of an observatory at Chamba. This being required chiefly for the study of Himalayan meteorology, especially in connection with the snowfall, is immediately under the Central Office, as are also those of Kailang in Lahoul and Leh in Kashmir. The remainder are administered by the Reporter to the Punjab Government and are briefly dealt with in Mr. Oman's report, Appendix C. The names of the superintendents and observers are given in Appendix CI.

As already noticed in the introductory portion of this report, the Lahore observatory has been at length removed from the Mayo Hospital, where it was originally established in 1872, to a building about 3 miles distant further from the city and in a more open and far more suitable site. This change was effected on the 1st January 1885. By this removal, which had become unavoidable, the conditions under which the observations are recorded have been materially changed; and, as has already been experienced in the case of the Calcutta and Allahabad observatories, it may be expected that the normal temperature, humidity, &c., of the new site will be found to differ very appreciably from those resulting from the observations of past years. In order to ascertain this difference approximately and to render the past registers comparable with those of the new observatory, observations of temperature and humidity will be carried on simultaneously at the two observatories, if possible, for two years. The observatory is still carried on the footing of a second class observatory; but since the close of the year under report, it has been furnished with the means of recording the temperature of the ground, and the duration of sunshine, and also with a Beckley's anemograph for registering continuously the direction

and movement of the wind, but this last instrument awaits the erection of a tower to the observatory before it can be usefully set up.

The only other second class observatory under the Punjab Reporter, that of Leh in Ladakh, was transferred to the Central Office, for administrative purposes in July 1884. This also has been removed from its former site, although but a short distance, and it has been attached to the actinometric observatory under the immediate supervision of Sergeant Rowland, the Actinometric Observer.

The observatories of Delhi, Rawalpindi, Ludhiana, Murree, Sialkot, Simla, and Sirsa were inspected by Dr. Lawrie, the Punjab Reporter, and those of Rawalpindi, Murree, and Simla also by myself. The report for the year having been drawn up by Mr. Oman, after Dr. Lawrie's departure, does not give the results of the latter's inspection.

The Murree observatory was found by myself to be in excellent condition as far as depended on the observer, and indeed this has always been one of the best observatories in the province. One or two instruments required cleaning or replacing, and this was effected during or in consequence of my visit. The Rawalpindi observatory was also in satisfactory condition.

The Simla observatory was removed from Bairdville (the house occupied by the Quarter Master General's Office) to the new military staff offices in Burra Simla in the second week in March. The distance is about a mile; and whereas the fromer site in Chota Simla had a western aspect, the slope of the hill on which the present observatory is situated faces to the south and the elevation of the barometer is 36·6 feet greater than before. As in the case of Lahore, the removal was unavoidable; and it is to be regretted that Bairdville being private property, only temporarily rented by the Government, it has not been practicable to carry on the observations there after the removal of the Quarter Master General's Office.

That some change in the normal or average values of the temperature and humidity registers has been introduced by the change can hardly be doubted, but how great or little it may be can only be a matter of surmise. The difference of the levels between the present and former sites of the barometer has however been very accurately determined by a double line of levels, taken by the direction of the superintending engineer Mr. Irvine. The present site is no better fitted than was the former site for wind observations, and indeed is only temporarily occupied for the purpose of the observatory. It is intended, on the completion of the Townhall, to remove the observatory to the ridge, or the immediate neighbourhood of that building.

The Delhi observatory was inspected by Mr. S. A. Hill while officiating as Reporter to the Government of India. It was found to be in a somewhat neglected condition, the barometer being very dirty, and the thermometer shed in bad repair. The hygrometer was coated with calcareous deposit. The thermometers, most of which had been in use for the past 10 years, was found in several cases to have risen about 0·5° in their scale values, introducing an uncorrected error of that amount into the registers.

The Sialkot observatory furnished some very erroneous reports towards the end of the year, and this was found on enquiry to be due to the repeated change of the observer, and to some of the temporary incumbents being almost wholly untrained.

Respecting other observatories, there is nothing specially calling for notice.

The following observers have had special allowances allotted to them for the current year:—

Names.	Stations.	Amounts.
		R
Jaspat Rai	Lahore	10
Devanchand	„	5
Wahid Ali	Mooltan	5
Kashi Ram	Peshawar	5
W. Cruikshank	Murree	5
Sergeant J. J. König	Simla	5

OBSERVATORIES IN THE CENTRAL PROVINCES.—The observatories of these provinces, eleven in number, are enumerated at page 3 of this report, and the nominal list of the superintendents and observers is given in Appendix D I., appended to report of the Sanitary Commissioner, Dr. J. H. Loch [Appendix D].

The Sanitary Commissioner has inspected all the observatories in his administration, excepting those at Seoni, Sambalpur, and Sironcha; and the results of his inspection are detailed in his report. The Jubbulpore observatory was also inspected by Mr. S. A. Hill.

Two of the second class observatories, Nagpur and Jubbulpore, have maintained their excellent character, but the Pachmarhi observatory, which is also of the 2nd class, has given cause for serious complaint; Dr. Loch found, on inspecting the observatory, in October last, that the observer systematically neglected the official instructions in his manner of reading the barometer, and as this had been the case for many months, the whole of the barometric registers, from February to October inclusive, have had to be rejected. The thermometer shed was blown down shortly before the inspection, and from that time to the 1st December, the temperature observations cannot be accepted as of much value, the instruments having been placed in a closed building.

Of the third class observatories inspected, the reports are generally favourable, the only serious exception to this remark is afforded by the Sambalpore and Sironcha observatories. At the former, in consequence of the removal of the observatory to a new site, arrangements had been made for simultaneous registration at the old and new observatories to determine the influence of the change on the normal values of the registers. It was found, on examination, that the permanent observer who was charged with the duties at the new observatory, had simply copied the thermometer readings furnished by the temporary observer at the old site, thus defeating the object of the double register.

The barometric registers of Sironcha were also untrustworthy during several months of the year; until the fact having been brought to the notice of the Sanitary Commissioner, the observatory was inspected by the Superintendent of the Chanda observatory in September 1884. The observatory and instruments were found to be in good order, and the bad work must, therefore, have been due to the carelessness or bad faith of the observer. Since he has learned, by this experience, that means exist of checking his work, by comparison with that of other observatories, his registers have ceased to show the former discrepancies.

Special allowances have been granted to the following observers in the Central Provinces for the current year:—

Names.	Stations.	Amounts.
		R
Krishna Rao	Raipur	5
Sitaram	Chanda	5
Puncham	Seoni	5
P. Soobiah	Nagpur	5
Behary Lal Parasar	Khandwa	5

OBSERVATORIES IN BERAR.—Of the five observatories in this province, enumerated at page 3 of this report, all but Makhla are under the Reporter for Western India, and are noticed in his report (Appendix F), the names of the superintendents and observers being given in Appendix FI. Those of the Makhla observatory, which is carried on by the officers of the Forest Department, are given in Appendix E.

None of these have been inspected during the year, but Mr. Chambers reports that the work of the observatories at Akola and Chikalda has been thoroughly trustworthy, while that of Amraoti and Buldana was for a short time open to objection, either owing to erroneous observations or to faulty manipulation of the instruments.

Special allowances have been granted to the following observers[1]:—

Names.	Stations.	Amounts. ₹
Samuel Gregory	Akola	10
Hera Lal	Chikalda	5

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—These are ten in number as in previous years, and they are enumerated at page 3. The Maharajah's observatory at Jeypore, which is a first class observatory, sends in its registers to the Reporter for the North-Western Provinces and Oudh, and a special report by the superintendent Surgeon-Major Hendley is given in Appendix BI.

Of the remaining observatories (all of the third class), those of Nowgong, Sambhar, Sutna, and Ajmere are noticed in Mr. Hill's report (Appendix B); and those of Neemuch, Indore, Mount Abu, and Bickaneer in that of Mr. Chambers, (Appendix F); and the lists of officers and observers are included in the lists respectively appended to these reports. That of the remaining observatory, Pachpadra, which reports direct to the Central Office, is given in Appendix E.

Sambhar and Sutna were inspected by Mr. Hill. With two small exceptions, the instruments at the former were found in good condition, and the work of the observatory is fairly performed. At Sutna everything was in excellent order except the Casella anemograph, which is reported to work stiffly, owing to some fault in construction.

Mount Abu, Neemuch, and Indore were inspected at the beginning of the year under report by Mr. Pearson, who officiated as Reporter for Western India during the greater part of the year. The condition of these observatories was noticed in Mr. Pearson's Report for the previous year.[2]

Mr. Chambers mentions that the registers of Mount Abu and Neemuch were for a short time 'unreliable.' The barometric registers of the former for June and July have had to be rejected, and that of the latter for November.

The Pachpadra observatory has worked satisfactorily during the past year.

Special allowances have been granted to the following observers for the current year:—

Names.	Stations.	Amounts. ₹
Ram Lal	Bickaneer	10
Har Nath	Sutna	5
Ram Pershad	Ajmere	5
S. K. Gadgil	Mount Abu	5
Trimbak Rao	Indore	5

OBSERVATORIES IN BOMBAY.—These, fourteen in number, are the same as in the previous year, and are enumerated at page 3. With the exception of the Colaba

[1] Bukarang Pandurang, the observer at Amraoti, subsequently received an allowance of ₹5.

[2] See Administration Report for 1883-84, p. 77.

observatory at Bombay, which is independent of the Meteorological Department, they are dealt with in Mr. Chambers' Report [Appendices F and FI].

Of the four second class observatories, three, *viz.*, Poona, Belgaum, and Kurrachee, were inspected by Mr. Chambers, and the fourth Deesa, was visited by Mr. Pearson and reported on in his report for last year. The results of Mr. Chambers' inspection are given in his report (paragraphs 15, 17, and 21). At Poona and Kurrachee, the instruments were in fair order; but at Belgaum the Beckley's anemograph was found to work badly, owing to its dirty and neglected condition. With one other exception, however, the remaining instruments were in good order. The registers sent in by these observatories are favourably reported on.

The third class observatories at Surat and Malegaon were inspected by Mr. Pearson at the beginning of the year, and those of Sholapur, Ratnagiri, and Karwar by Mr. Chambers. These last alone are noticed in the report [Appendix F, paragraphs 17, 18, and 20]. The condition of the Ratnagiri and Karwar observatories was satisfactory. That of Sholapur less so, owing, as would appear, to a want of intelligence on the part of the observer. Portions of the registers of Hyderabad, Bhuj, and Malegaon have been rejected.

Special allowances have been awarded to the following observers:—

Names.	Stations.	Amounts.
		₹
Mahadev Cuddum	Ratnagiri	10
Ramkrishnâ K. Karandikar	Deesa	5
Narayen Sakaram	Poona	5
Govindrag C. Moodlair	Rajkot	5
G. W. M. D'Aranjo	Karwar	5
Ram Chunder Datta	Belgaum	5

OBSERVATORIES IN MADRAS, MYSORE, COORG, AND HYDERABAD.—Of the nineteen observatories enumerated on page 3 all but Madras, Vizagapatam, and Gopalpur are under the Meteorological Reporter to the Government of Madras, and a detailed account of their working during the past year is given in Miss Pogson's report (Appendix G). Nine of these have been inspected by Miss Pogson during the year, *viz.*, the second class observatory at Trichinopoly and the third class observatories at Bangalore, Cochin, Coimbatore, Kurnool, Madura, Negapatam, Salem, and Secunderabad. Two others, *viz.*, Cuddapah and Masulipatam, have been visited and reported on by the head clerk of the Madras office. The detailed result of the inspection are given in Miss Pogson's report. The observatory of Cuddapah was established only a few days before the beginning of the year under report, that of Rajahmundry in May 1884.

The majority of the observatories are favourably reported on, and in general the work of the province has been much improved since Miss Pogson has been appointed to the reportership. The observatories of Bangalore, Cochin, Coimbatore, Mangalore, Mercara, Negapatam, Selem, Secunderabad, Trichinopoly, and Wellington are very favourably noticed as far as depends on the observers. That of Bellary is in general satisactory, but the observer has given reason for complaint by his dilatory conduct in completing and sending in his registers. Those of Cuddapah, Kurnool, Madura, and Masulipatam have been less satisfactory, and much of the work contributed by the two first mentioned has had to be rejected.

It is necessary to remark, with reference to the insufficient supply of instruments occasionally noticed in the report, that, except occasionally in the case of radiation

thermometers, all requisitions from the Madras office have been immediately supplied, and in some instances instruments have been sent to observatories requiring them, in anticipation of any action on the part of the Reporter's office.

The observers at those observatories in Madras, which were established before the reorganisation of the department under the Government of India, have been paid at a higher rate than at those more recently established, *viz.*, Mercara, Mangalore, Cuddapah, Kurnool, and Rajahmundry, and it has not been deemed advisable to reduce the emoluments of the former to the same scale as the latter, so long as the observatories continued to work satisfactorily on the old system. The more highly paid observers were, however, required to reduce and correct their own registers and thus save some expense to the Reporter's office. This system, however, has not proved satisfactory in many cases, and steps have therefore been taken gradually to reduce both the work and rates of remuneration at the old observatories of the 3rd class, as the former incumbents vacate their appointments. This has been done at Coimbatore and Madura from the 1st June of the year now current, and at Masulipatam from the 1st July, thus effecting a considerable saving of expense, even after providing a small additional establishment for the extra work thrown on the Reporter's office by the change of system.

The Vizagapatam observatory, the private property of Mr. Nursing Row, has continued to furnish its very valuable registers as in former years, and also to transmit daily weather telegrams, both to Calcutta and Simla.

The Gopalpur observatory, established in connection with the system of telegraphic storm report issued by the Bengal Office, works under the direction of that office.

The Madras observatory is, as heretofore, a part of the establishment of the astronomical observatory and is independent of this department.

OBSERVATORIES IN BRITISH BURMA.—These observatories, eight in number as in previous year, are enumerated at page 3. The name of the observer at Akyab is given in the Bengal Report, (Appendix A), that of Diamond Island in Appendix E, and the names of the superintendents and observers of the remainder in Appendix H I. These last are under the Sanitary Commissioner of British Burma, whose report forms Appendix H. All these have been inspected by the Sanitary Commissioner, who reports that at Bassein, Moulmein, and Mergui all the instruments were found to be in good order, and also reports favourably of the observers generally. The observatory of Toungoo was removed to a different site on the 1st May. The barometric registers of this station after correction for the change of elevation are found not to be comparable with those of previous years, but this may be due to some uneliminated error affecting those of past years.

As far as can be judged from the registers, the work of the Burma observatories generally has been more satisfactory during the past year, and Mr. Pedler reports to a similar effect in the case of Akyab.

A special allowance of ₹5 has been continued to the Moulmein observer, Mr. P. H. Hilbert, for the current year.

OBSERVATORIES AT THE BAY ISLANDS.—The observatories of Port Blair and Nancowry have worked satisfactorlly during the past year; and a special allowance of ₹5 has been continued to Mr. J. F. Peters, the observer at the former station. The names of the superintendents and observers are given in Appendix E.

EXTRA INDIAN OBSERVATORIES.—Eight of these were enumerated in the report for last year. But that of the Seychelles has ceased to contribute any register since January 1884, and owing to the transfer of the Political Agency of Zanzibar to the Home Government, and the consequent withdrawal of the Indian medical establishment, the work of the observatory at that station became irregular, and finally ceased in December 1884. This occurred on the death of the Agency Surgeon Mr. Williams, who, for some months after the withdrawal of the native observer, had carried on the observations with such regularity as was practicable. The loss of this observatory is much to be regretted, chiefly on account of the information it afforded respecting the meteorological condition of that part of the Indian Ocean.

The observatories of Aden and Bushire have continued to furnish very satisfactory registers, and these, together with the abstract of the Mauritius observations, for which I am indebted to Mr. Meldrum, F.R.S., the Director of the Royal Alfred observatory, are now the only data received from stations distant from India (except such as reach us in a published form, more or less after date). The observatory at Amini Divi in the Lakhadives has been re-established, but owing to the difficulty of communication with the island during the monsoon, the registers from April to November did not reach the Madras office until January 1885. This delay must in any case very seriously detract from their utility. They are, however, reported to be of a satisfactory character. A further drawback is that, owing to the departure of the observer and his temporary return to India, they have been again interrupted from the 26th December 1884 to the 22nd April 1885, an interval of four months.

The Leh observatory has furnished excellent work during the past year, under the immediate supervision of Sergeant Rowland, the actinometric observer. It has been transferred from the administration of the Punjab Reporter to that of the Central Office. The Quetta observatory has worked satisfactorily, and the information furnished by it has become of much importance in connection with the increase of the military establishments in Beluchistan. It will probably be found desirable shortly to extend the system of meteorological observation on this frontier.

The Katmandu observatory has been less satisfactory, and owing to the residency being under reconstruction, the barometric registers have been discontinued during the year.

INSTRUMENTS.

In Appendix I is given a return of the instruments in store at the beginning of the year, and of those received and issued by the Calcutta Meteorological Office, and includes the stock, receipts, and issues of the Alipore observatory; and in Appendix K is a return of the instruments issued to each observatory. In this are incorporated the returns furnished by the local Reporters.

METEOROLOGICAL OFFICES AND OFFICE WORK.

The general administration of the meteorological observatories and offices in the

different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the year :—

Name.	Office.	Province.
H. F. Blanford, F.R.S. W. L. Dallas, Esq.	Meteorological Reporter to the Government of India Assistant Meteorological Reporter to the Government of India	Central Office.
John Eliot, M.A. A. Pedler, Esq. (Offg.)	Meteorological Reporter to the Government of Bengal	Bengal and Assam.
Dr. Murray Thomson (Offg.) S. A. Hill, B.Sc.	Meteorological Reporter to the Government of the North-Western Provinces and Oudh	North-Western Provinces, Oudh, Rajputana and Central India (part).
Dr. E. Lawrie	Meteorological Reporter, Government of Punjab	Punjab.
A. N. Pearson, Esq. (Offg.) F. Chambers, Esq.	Meteorological Reporter for Western India	Bombay, Berar, Rajputana and Central India (part).
Miss Isis Pogson	Meteorological Reporter, Government of Madras.	Madras, Mysore, Coorg and Hyderabad.
Dr. J. H. Loch	Sanitary Commissioner, Central Provinces	Central Provinces.
Dr. Little	Sanitary Commissioner, Berar	Berar.
Dr. D. Sinclair	Sanitary Commissioner, British Burma	Burma.
Surgeon-Major J. Reid „ „ W. N. Keefer	Senior Medical Officer, Bay Settlements	Andamans and Nicobars.

I was absent on privilege leave from the 10th December 1884 to the 10th March 1885, during which Mr. S. A. Hill officiated as Meteorological Reporter to the Government of India in addition to his own special duties.

Mr. John Eliot took leave on furlough on the 9th December 1884, since which time Mr. A. Pedler has officiated as Meteorological Reporter to the Government of Bengal.

Mr. S. A. Hill returned from furlough and resumed charge of his office as Meteorological Reporter to the Government of the North-Western Provinces and Oudh on the 21st October 1884, up to which time Dr. Murray Thomson had officiated from the beginning of the year.

Mr. A. N. Pearson continued to officiate as Meteorological Reporter for Western India up to the 10th November 1884, on which date he was relieved by Mr. F. Chambers, who resumed charge of his office.

In the Punjab and Madras the permanent incumbents remained in charge of their respective offices during the whole of the year under report.

Mr. Dallas, Assistant Meteorological Reporter to the Government of India, took his departure on privilege leave on the 31st March 1885, one day before the close of the year.

The following table shows the number of stations, the registers of which were sent to

each of the Reporters respectively for reduction and verification during the year under report:—

Provinces.	Meteorological Reporters.						Total.
	India.	Bengal.	North-Western Provinces and Oudh.	Punjab.	Western India.	Madras.	
Bengal and Assam	4	19	...	...	...	...	23
North-Western Provinces and Oudh	2	...	14	...	...	...	16
Punjab	2	...	...	11	...	...	13
Rajputana and Central India	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay	...	...	...	..	13	...	13
Madras, Mysore, and Coorg	1	1	...	...	...	16	18
Burma	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	5	...	...	...	1	1	7
Total	36	21	18	11	22	17	125

This list does not include the registers of the provincial observatories in Bengal, nor those of Colaba observatory, Bombay, Goa, and Jeypore which are furnished to the Meteorological Office with all the necessary reductions.

In Bengal, the North-Western Provinces, and Bombay (in part), the reporters superintend the rainfall registers of the district and sub-divisional stations of their respective provinces, and prepare weekly and monthly returns of the rainfall, *viz.*:—

Bengal	172[1]
North-Western Provinces and Oudh	253
Bombay	400?

During the past year, steps have been taken considerably to extend the rainfall registration in Bengal. It has been pointed out, by Mr. Pedler, that certain parts of the povince, more particularly Chutia Nagpur, are very inadequately represented by the existing rainfall registers. In Chutia Nagpur, nearly 27,000 square miles of country are represented by only 11 rain-gauge stations. It has, therefore, been proposed to establish 72 additional stations, making a total of 244, and this proposal has been sanctioned and put in execution since the beginning of the current year.

Mr. Hill has undertaken a comparison of the registers, obtained hitherto at the sudder stations of the North-Western Provinces, with the old Fleming (float) gauges and the more trustworthy Symons's (measure glass) gauges supplied two years since. He finds that while, at about half the stations, the returns furnished by the old gauges are fairly accurate, at some of the others the error amounts to as much as 20 per cent.; also that, on the whole, the proportion of erroneous gauges in the North-Western Provinces is less than in Oudh. The published charts of rainfall for the North-Western Provinces, which have been drawn up in a great measure from the data furnished by the old gauges, show therefore not a few errors of detail.

[1] 156 excluding stations at which observatories also exist.

In Madras, the Revenue rain-gauge stations are not at present under the administration of the Meteorological Office, but the Reporter mentions that it is in contemplation to effect their transfer at an early date.

The Reporters for Bengal and Western India also administer a system of storm warnings for the protection of the local ports, and the Bengal Reporter has in addition the working of a system of daily telegraphic weather reports from the 15th May to the 15th November. He also collects the meteorological observations from the log-books of ships entering the port of Calcutta.

Mr. Dallas, Assistant Meteorological Reporter to the Government of India, has been in charge of the Imperial system of daily weather reports up to the 30th March, when he took privilege leave. He also prepared monthly and semi-annual summaries of the weather reports, and has continued the reduction of the marine observations received from the London Meteorological Office and the preparation of charts of the Bay of Bengal, showing the distribution of barometric pressure, the prevalent winds, and marine currents in each month of the year. These are now complete, and he is proceeding with the preparation of similar charts for the Arabian Sea and those of the density of the sea-water in the Bay of Bengal. The charts showing the distribution of air temperature and the temperature of the sea will be deferred until the more important series of charts are completed for the whole area.

With a view to relieving Mr. Dallas of some of the more mechanical duties connected with his work, it was proposed, during the past year, to train an educated native to prepare the daily weather reports and charts; and after some enquiry from the principals of the chief colleges of Upper India, a competent candidate Ruchi Ram Sahni, M.A., was selected on the recommendation of the Principal of the Lahore College and appointed on probation on the 10th January 1885. Some time before Mr. Dallas's departure on leave, he had practised the work of the daily reports under Mr. Dallas's supervision, and afterwards under my own, and he now gives good assistance in this part of the office work.

OFFICE ESTABLISHMENT.—The following is a return of the number of permanent employés (ministerial officers and menials) in the offices of the several Meteorological Reporters:—

	India.	Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	TOTAL.
Head Clerks	1	1	1	1	1	1	6
Computers	3	...	...	...	1	...	4
Clerks and Copyists	3	2	1	2	...	3	11
Tabulators	18[1]	7	4	...	5	...	34
Draughtsmen	3[2]	1	...	...	...	...	4
Artisans	...	3	...	...	...	...	3
Peons and Menials	10	4	2	1	2	1	20

[1] Besides these, there are four temporary clerks for reducing the London Meteorological Office marine logs.

[2] Besides these, there is one temporary draughtsman for drawing up marine charts.

The Central Office has remained under the charge of the Head Clerk, Babu Fanindra Mohun Basu, and has been conducted in a most satisfactory manner. I have recommended that, in consideration of the large amount of responsible work which devolves on this officer, and also of the excellent manner in which he has managed the office for many years past, the salary of his appointment should be raised.

The Head Computer, Babu Nirduksha Kumar Ghosh, deserves mention for his careful superintendence of the computing work of the office; and as his duties demand an acquaintance with advanced mathematics, I have recommended that his appointment also be placed on a better footing. These recommendations have been conditionally approved, and, together with some other recommendations for the improvement and strengthening of my own and the provincial offices, will, I anticipate, take effect as soon as financial considerations will admit of them.

The Reporters for Bengal, the North-Western Provinces and Oudh, and the Punjab speak in favourable terms of the conduct of their respective establishments.

The Madras Meteorological Office has now been entirely removed from the observatory, of which at one time it formed an integral part. This office as well as that of the Reporter for the Punjab and that of the Reporter for Western India require strengthening, and I am in hopes that this may be effected during the current year.

WEATHER BULLETINS AND STORM SIGNAL SERVICE.—The daily weather reports of the Imperial Office were issued at Simla from the 1st May to the 31st October, and from Calcutta during the remainder of the year. Arrangements have been made to carry on this work permanently at Simla in future, and an establishment of Punjabi clerks has been partly formed for the purpose, a corresponding reduction being made in the establishment of the Calcutta Office. The weather reports are issued in the same form as in the previous year. The verbal summary, which accompanies each issue, is telegraphed to all the Provincial Governments, and copies are furnished to the daily newspapers at Calcutta, Allahabad, and Bombay.

As a part of the work connected with the daily reports, notice is sent by urgent telegram to the Meteorological Office, Bombay, of the progress of any storms that advance from the Bay of Bengal towards the western presidency; and arrangements were made during the past year, in correspondence with the Government of Bombay, for sending notice by urgent telegram to the Civil and Political Officers of Khandesh and Guzerat of the appearance of storms that are likely to produce floods in the Tapti and Nerbudda; also for telegraphing direct to the same officers, from certain observatories in the upper drainage basins of these rivers, the occurrence of heavy rain, in order to give them due warning of probable floods. These arrangements have been in operation during the present monsoon.

In Bengal, the daily weather report for the province, containing telegraphic reports from 32 stations together with a verbal summary, was issued regularly from the 16th May to the 7th November, and Mr. Pedler reports that it is becoming appreciated by the general public, as is manifested by a considerable increase in the number of subscribers. In addition to these, daily reports of the weather at 19 stations round the coasts of the Bay are issued with a weather chart, the form and appearance of which has been much improved. This is printed daily in the Meteorological Office and is issued to 27 subscribers and to 37 Government officers.

The storm signals have been worked as in former years. No very severe cyclone occurred in the Bay of Bengal during the year, but a number of small cyclonic storms were formed during the monsoon, chiefly at the head of the Bay, and advanced different distances across the land. Of these there were two in June, six in July, two in August, four in September, and two in October. Most of these were of small intensity, and the storm signals were hoisted only on two occasions.

In Bombay, the storm signal service has been carried on as in previous years. But this coast, like the Burmese coast of the Bay of Bengal, is but rarely visited by cyclonic storms, and there has not been occasion to hoist the signals once during the year. No daily weather reports are published by the Bombay Office.

WEEKLY, MONTHLY, AND SEMI-ANNUAL REPORTS.—From May to October inclusive, a monthly descriptive summary of the chief weather characteristics of the month, based on the telegraphic reports, was prepared in the Simla Office and published in the Gazette; and from November 1884 to April 1885, a similar report was prepared in alternate months. In May and November, a general review of the weather of the preceding half-year was drawn up and published in like manner.

In addition to the above periodical reports, special reports were drawn up in May and June on the Himalayan snowfall of the preceding winter and spring, and on the strength of these reports an attempt was made, as in the previous year, to forecast the character of the monsoon rains. The result has already been noticed in Part II of this report, and for a second time has justified the terms of the prognosis. During the present year, success has been still more marked, and the experience has very greatly confirmed public confidence in the justice and validity of the views on which these forecasts are based.

Charts showing the average distribution of the rainfall of India in the three seasons, the cold season (November to February), the hot season (March to May), and the rainy season (June to October), have been prepared, and several copies furnished to Government. Also charts on a similar plan and scale, showing the actual distribution of the rainfall in the corresponding seasons of the past year, have been prepared and submitted in like manner, but these are not published.

Weekly and monthly meteorological and rainfall reports of the province are drawn up by the Bengal Reporter, and published in the *Calcutta Gazette*; and during the monsoon, four sets of three rainfall charts of the province, showing the distribution of the rainfall and its variation from the average, are prepared for the Local Government.

In the North-Western Provinces and Bombay, abstracts of the meteorological observations and of the rainfall have been published in the local Gazette as in previous years.

ANNUAL REPORTS.—The report on the meteorology of the year 1883 was complete and in the printer's hands, by the beginning of December, and the printed report was submitted to Government on the 1st June 1885. As is usually the case, the text was completed several weeks in anticipation of the plates.

The report gives tables of temperature for 134 stations and rainfall returns of 462 stations, being an increase of four of the former and five of the latter on the numbers respectively given in the report for 1882. The returns of most other meteorological elements

are nearly as numerous as those of temperature. The elements tabulated in the Appendix are as follow. For comparison I give similar tables for the last five years.

	Number of Stations.					
	1878.	1879.	1880.	1881.	1882.	1883
Equilibrium temperatures of solar radiation	99	106	109	106	112	111
Duration of bright sunshine	...	...	...	...	...	2
Temperatures of nocturnal radiation	97	100	108	106	104	107
Temperatures of the ground	...	...	2	4	4	4
Mean and extreme air temperatures	116	123	126	131	130	134
Sea-level equivalents of mean temperatures	100	101	105	108	108	111
Means and extremes of atmospheric pressure	113	119	122	125	124	125
Sea-level equivalents of mean atmospheric pressure	96	98	105	107	108	109
Direction and movement of winds	113	118	124	127	125	127
Temperature of evaporation	106	111	115	121	120	124
Tension of atmospheric vapour	113	120	123	128	127	130
Mean relative humidity	114	120	123	128	127	130
Mean proportion of clouded sky	110	118	122	125	124	127
Inches of rainfall in each month	253	365	399	417	457	462
Number of days on which rainfall was measured	276	365	379	403	457	462

The descriptive letter press discusses the chief characteristics of the meteorology of the year. It includes tables of the average values of all the more important meteorological elements for all stations that have furnished returns for three years and upwards, and the report is illustrated with nine plates, *viz.*, a chart showing the position of all observatories and rain-gauge stations; three in coloured lithography, representing the mean distribution of temperature, pressure, and winds in each month of the year; and five illustrating certain cases of rainfall in the cold weather, the weather during a period of excessive drought in May, and also that of the rainy period which followed; the setting in of the rains in Bengal, and the simultaneous formation of two independent storms in November, in North-Western India, and in the Andaman Sea.

The original observations of six observatories, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay, and Madras, were issued in a distinct publication in monthly parts. Those forming the volume for 1883 were completed in May 1884, and those for 1884 in July 1885.

MISCELLANEOUS PUBLICATIONS.—Part III of the second volume of the Indian Meteorological Memoirs, containing a very carefully worked out memoir by Mr. Eliot, on the storm of the 8th and 9th October 1882, in the Bay of Bengal, was issued in November 1884. Part IV containing another long and elaborate memoir, also by Mr. Eliot, on the storms of the Bay of Bengal during the years 1877 to 1881, was printed and nearly ready for issue at the close of the year, and part V which will conclude the volume is now nearly ready for issue. This contains a paper by Mr. S. A. Hill, on observations of temperature and humidity, at 4 and 40 feet above the ground surface, made during three years at Alipore; and also the general index to the volume.

Other memoirs now in the press, or in hand and shortly to be sent to press, are, a memoir on the rainfall of India, which with plates and tables will form Volume III; a memoir by Mr. Eliot on the Akyab cyclone of May 1884; and a short paper by Mr. W. L. Dallas on the meteorology of the southern central portion of the Bay of Bengal. These two papers will form the first part of Volume IV.

A paper on the "Theory of the Winter Rains of Northern India" was published in No. 1, Part II of the Journal of the Asiatic Society of Bengal for 1884; and an "Account of the south-west monsoon storms of June, July, and November 1883" by Mr. Eliot in No. 2 of the same part and volume. A paper by Mr. S. A. Hill on "Observations of the solar thermometer at Lucknow" was also communicated to the Asiatic Society of Bengal and published in No. 1, Part II of the Society's Journal for 1885. Mr. Pearson, when officiating as Reporter for Western India, contributed to the proceedings of the same Society a note on the variations of the rainfall of Northern India, and Mr. F. Chambers, a short note, of controversial character, on one of the above papers.

In addition to the above, a paper by myself "On the connection of the Himalayan snowfall with dry winds and seasons of drought in India" was published in the proceedings of the Royal Society for May 1884, and Mr. Pearson contributed to the Royal Meteorological Society of London a paper entitled "Some results of an examination of the barometric variations in Western India" and a description of a new component anemograph invented by himself. The former was published in the Society's Journal for October 1884; the latter given in abstract in the January number for 1885.

Although not the work of an officer of the department, I may also mention as being in part the outcome of the work of the department, a very interesting paper by Dr. D. Brandis, late Inspector General of Forests in India "Die Beziehungen zwischen Regenfall und Wald in Indien," communicated to the "Niederrheinische Gesellschaft für Natur und Heil-kunde" at Bonn, at a meeting at which I was present in January last. This has since been published in the proceedings of the Society.

Appendix L gives a list of the Government officials, libraries, observatories, societies, &c., to which the publications of the office are presented including those which send their own publications in exchange.

LIBRARY.

Since the transfer of the Calcutta Meteorological Office to a larger building, it has been possible to devote a room to the large and increasing library which has hitherto

been scattered through the office. New book-cases have been provided, and it will be possible now to re-arrange the library in such manner as to make it readily accessible for reference, provided, that is to say, the office remains in its present commodious quarters. Until this point shall be decided, it will be of little use to undertake its re-arrangement.

A list of the additions to the library is given in Appendix M.

HENRY F. BLANFORD,

Meteorological Reporter to the Government of India

SIMLA:
The 17th August 1885

APPENDIX A.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Bengal for the year 1884-85.

The Bengal Meteorological Department was under the control of the permanent head of the department, Mr. John Eliot, from the beginning of the official year until the 9th of December 1884, when Mr. Eliot proceeded on furlough. From this date till the close of the official year the department has been under my charge.

During the year under review, the extended scheme of meteorological observation, and the special arrangements for the speedy transmission of the meteorological and rainfall observations taken throughout the province, together with their speedy reduction, collation and publication through the various publications of this office, which were sanctioned in the year 1882-83 and brought into action in 1883-84, have been carried out steadily. The details as to the extent and nature of the observations which are now made, together with the method of collection of the returns, and the manner in which such returns are utilized for the information of Government and for subsequent publication, have already been fully described, first, in the form of proposals in the Administration Report of 1882-83; and secondly, in the Administration Report of 1883-84, where a full description was given of the arrangements which had been made to carry out the wishes of the Bengal Government in this matter.

During the year there has been no change or addition to the number of the regularly constituted observatories in Bengal and Assam of the second and third classes. There was only an addition of one observatory to the list of provincial third class stations, *viz.*, Bogra, which was started from the 2nd December 1884. The total number of stations thus reporting to the Bengal Meteorological office during the year were seven second class, fifteen third class, and twenty-three provincial third class observatories.

Sanction was given to the establishment of observatories at three other stations during the year, *viz.*, one at Tezpore in Assam, which is to be an imperial third class observatory, and two other provincial third class stations at Kishnaghur and Maldah in Bengal. But owing to difficulties in the selection of suitable sites for the observatories and to other delays, they could not be started within the official year. In the case of Tezpur and Kishnaghur, Mr. Eliot found it necessary personally to visit the stations for the selection of the sites for the respective observatories. The Magistrate of Bankoora (Mr. Anderson) proposed to start a voluntary observatory at his station, which would furnish observations for the Bengal daily weather report, and sanction was given to this proposal by the Meteorological Reporter to the Government of India in August 1884. A shed was provided by this department, and it is hoped that the observations which will be received will be useful to give indications of the weather over a large area which is practically now unrepresented by any regular station, except distantly by Raneegunge.

Second class observatories.—These are seven in number. Five are in Bengal and the remaining two in Assam. The names of the superintendents and observers at these stations are given in the following table:—

Second Class Stations.

Stations.	Superintendents.	Superintendents' allowances.	Observers.	Observers' allowances.	Assistant observers.	Assistant observers' allowances.
		R		R		R
Sibsagar	Dr. T. D. O. Partridge[1]	30	Babu Dandadhur Dutt Borua.[3]	30	Babu Ratneswar Gogoi.	10
	„ C. J. Atkins.[2]					

[1] From 1st April 1884 to 17th February 1885. [2] From 18th February to 31st March 1885.
[3] Received special allowance of R10 per month for meritorious services.

Second Class Stations—contd.

Stations.	Superintendents.	Superintendents' allowances.	Observers.	Observers' allowances.	Assistant observers.	Assistant observers' allowances.
		R		R		R
Dhubri	Dr. Edwin Dobson	30	Munshi Manirud-deen Ahmed.[1] Munshi Kadimud-deen Ahmed.[2]	30	Babu Ambica Prosad Dey.	10
Hazaribagh	„ R. Cobb[3]	30				
	„ J. Wilson[4]	.....	Babu Nathoolal*	30	Babu Dwarknath.	10
	Babu T.C. Das.[5]					
	Dr. C. J. W. Meadows.[6]					
Bankipore	Dr. J. G. French[7]	30	Munshi Mohubbut Lal.	30	Babu Muddun Mohun Lal.	10
	Baboo Ramkali Gupto.[8]					
	Dr. W. A. Gilligan.[9]					
Saugor Island	.....	.....	Mr. J. A. Thomas	45	*Nil.*	*Nil.*
Cuttack	.....	.....	„ H. W. Alley*	32	Mr. B. Sebastian	13
Chittagong	.....	.....	„ P. O. Pereira „ J. E. Gabriel	30	Mr. J. Dias „ E. J. J. Tixura.	15

[1] Died on 2nd November 1884.
[2] From 1st November 1884 to 31st March 1885.
[3] From 1st April 1884 to 7th July, and 8th August to 3rd February 1885.
[4] From 8th July 1884 to 7th August 1884.
[5] From 4th to 10th February 1885.
[6] From 11th February 1885 to 31st March 1885.
[7] From 1st April 1884 to 5th August 1884, and 6th September 1884 to 31st March 1885.
[8] From 6th August to 15th August 1884.
[9] From 16th August 1884 to 5th September 1884.

* Received special allowance of Rs per month for good services.

Five of these observatories are provided with self-registering anemographs. The anemographs at Dhubri, Hazaribagh, and Cuttack are of the Casella pattern, which record the wind direction and amount at intervals of one hour. The remaining two stations, Saugor Island and Chittagong, are provided with Beckley's anemographs, which register wind direction and amount continuously. There were very few breaks exceeding 24 hours in the working of these self-recording instruments, and in the majority of instances the cause of them has been the necessity for cleaning and repairing the instruments, and there have been extremely few stoppages which could possibly have been avoided.

Two of these observatories were visited during the year, *viz.*, Hazaribagh and Cuttack, by my head clerk, who reported as follows:—

"The *Hazaribagh* observatory was inspected on the 26th October 1884. No change has been made in the position and exposure of the instruments since the last inspection of the observatory by

Mr. Eliot in December 1882. The observer was punctual in taking the observations, and, generally speaking, the condition of the observatory was fair, but there were some defects which call for notice.

"The anemograph was found to work smoothly, but the chain connecting the wind-vane to the recording part of the instrument was found to have lengthened slightly, and failed to secure a good hold of the cog-wheels for fixing the direction indicator on the dial of the instrument. One link was therefore taken off the chain to remove the defect, and the instrument worked more satisfactorily. The anemometer requires to be changed for a better one, as it works rather heavily.

"The pad of the grass minimum thermometer was in shreds. The grass minimum was being exposed on grass on earth. The observer should have reported these facts.

"I examined the observer and his assistant thoroughly, and found that both did well and read the instruments fairly. They make very few mistakes.

"The records of the observatory were all in confusion."

The observatory has continued to maintain a good character for correct and punctual submission of returns, but the inspection report shows that, though in fair working order, it was scarcely in such good condition as would have been the case had the observer taken a warm and intelligent interest in his work, and his personal allowance was only retained on his assurance to pay proper attention to his duties.

Cuttack observatory "was inspected on the 3rd February 1885. No change of importance has been made in the position of the shed or in the arrangement of the instruments since Mr. Eliot's inspection in January 1883. The thermometer shed required repairs. The instruments were clean and in very satisfactory condition. The observatory continues to maintain its high character, and is thoroughly satisfactory in its equipment and accurate and valuable in its observations. Mr. Alley, the observer, and his assistant, were examined, and both acquitted themselves well, and were correct and quick in their observations." The observatory has been provided with a lightning-conductor at the expense of the Meteorological Department for the protection of the wind instruments.

The Dhubri observatory shed was destroyed by fire on the 6th April 1884. Complete observations had therefore to be suspended from that time to the first week of November 1884, when a new shed was built and the observations resumed. Incomplete observations, however, were telegraphed to the Meteorological Reporter to the Government of India, giving the barometer readings and the wind and rain observations for the purposes of the India weather reports. Observer Maniruddin Ahmed, who was a recipient of a ten-rupee special allowance, was granted sick leave for six months from 6th May 1884, and as the full set of observations had to be suspended, it was not found necessary to arrange for another head observer, but the assistant observer carried on the partial observations necessary. Observer Maniruddin Ahmed died on the 2nd November 1884, and Kadimuddin Ahmed was appointed in his place on probation.

The rest of the observatories of the second class continued to furnish very satisfactory returns throughout the year. There have been very few breakages of the instruments in these stations. In some, however, old instruments have had to be replaced either for defect or for their being worn out by long use. At Cuttack the sun radiation thermometer was broken by a sudden hailstorm while under exposure. Owing to the breakage of this instrument, which had been always exposed on forked sticks according to the old plan, it was considered desirable, when a new instrument was supplied in May 1884, to bring its conditions of exposure into conformity with the standard regulations in the *vade-mecum* by providing the observatory with the usual stand for the exposure of the sun thermometers.

The readings of the Saugor Island barometer had to be rejected for the period 8th February to 15th March 1885, consequent on the instrument having become useless by leakage of the mercury from the cistern. It was replaced by a new instrument with the least possible delay.

It will thus be seen that, on the whole, the work at the second class stations has been very satisfactorily performed, and that it has been fully equal to that of former years. The returns have been punctually submitted, and there have been few, if any, causes of complaint in the working of these stations.

Imperial third class observatories.—These are fifteen in number. Ten are situated in Bengal, one, Akyab, in Burma; two, Silchar and Tura, (voluntary observatory) in Assam; and two, Gopalpore and Coconada, in Madras. The two last are maintained in connection with the Bay of Bengal storm signal service.

The following table gives the names of the superintendents and observers at these observatories during the year 1884-85 :—

Stations.	Superintendents.	Observers.	Observers allowance
Darjeeling, St. Paul's School.	R. Carter, Esq., Rector, St. Paul's School, Darjeeling.	Mr. W. Moore	R 25
Purneah	D. Picachy, Esq.	Rajani Kant Chackervarti	15
Purbhanga	W. A. Gilligan, Esq.[1] Nobin Chunder Dutt [2] W. A. Gilligan, Esq. [3] J. C. Shaw, Esq. [4]	Jogin Chandra Banerjee	*Nil.*
Gya	Dr. R. Macleod, M.D.	Nowrungee Lall	15
Berhampore	Dr. S. M. Shircore [5] „ Beny Madhub Bose	Mahendra Nath Roy*	15
Burdwan	Dr. R. D. Murray [7] „ H. B. Purves [8]	Mokhoda Prosad Chowdhry* [9] Makhon Lall Chowdhry [10] Haroo Shaikh [11]	15
Jessore	Dr. D. W. D. Comins [12] „ R. D. Murray [13] „ W. Beatson [14] „ J. B. Gibbons [15] „ W. Beatson [16]	Paresh Nath Roy Chowdhry	15
Dacca	*Nil*	Mr T. W. deSouza	15
Silchar	Dr. J. J. Monteath [17] „ H. C. Banerji [18] „ T. d'O. Partridge [19]	Romesh Chundra Bhadro	15
Demagiri	*Nil*	Surjya Kumar Ghosh [20] Girish Chandra Bhar [21] Rajany Kanta Bose [22] Girish Chandra Bhar [23]	*Nil.*
False Point	*Nil*	Mr. E. Workman (assisted by Mr.) London).	25
Akyab	*Nil*	Mr. H. J. Smythe [24] „ E. B. Atkinson [25]	15
Tura	Dr. J. McNaught [26] „ P. M. Gupta [27]	Abdul Majeem	Voluntary
Gopalpur	Captain A. L. Taylor [28] Mr. M. Broom [29] Captain J. H. Fletcher [30]	Goona Appalananarsimhum	15
Coconada	Port Officer	Mr. C. J. M. Gaëtane	15

[1] 1st April to 15th August 1884.
[2] 16th August to 7th September 1884.
[3] 8th to 16th September 1884.
[4] 17th September 1884 to 31st March 1885.
[5] 1st April 1884 to 21st March 1885.
[6] 22nd to 31st March 1885.
[7] 1st to 13th April 1884.
[8] 14th April 1884 to 31st March 1885.
[9] 1st April 1884 to 8th January 1885 and 20th February 1885 to 31st March 1885.
[10] 9th January 1885 to 6th February 1885.
[11] 7th to 19th February 1885.
[12] 1st to 18th April 1884.
[13] 19th April to 2nd July 1884.
[14] 3rd July to 5th October 1884.
[15] 6th October to 4th November 1884.
[16] 5th November 1884 to 31st March 1885.
[17] 1st April to 11th November 1884.
[18] 12th November 1884 to 18th March 1885.
[19] 19th March to 31st March 1885.
[20] 1st April to 23rd September 1884.
[21] 24th September 1884 to 31st January 1885
[22] 1st February to 16th March 1885.
[23] 17th March to 31st March 1885.
[24] 1st April to 13th May 1884.
[25] 14th May 1884 to 31st March 1885.
[26] 1st April 1884 to 2nd February 1885.
[27] 3rd February to 31st March 1885.
[28] 1st April to 21st August 1884.
[29] 23rd August to 16th November 1884.
[30] 17th November 1884 to 31st March 1885

* Received a special allowance of Rs. [illegible] per month for meritorious [illegible]

Of the third class observatories very few required inspection. Five stations only were visited during the year—Darjeeling, Durbhanga, and Jessore by Mr. Eliot, and Gya and False Point by my head clerk.

The Casella anemograph, provided in 1882 for the Darjeeling observatory, having failed to give workable anemograms, particularly during the cold weather months, notwithstanding that the observer, Mr. Moore, and the Superintendent, Mr. Carter, had devoted much time and skill in endeavouring to make the instrument work satisfactorily, Mr. Eliot thought it desirable to personally inspect its working at a period when it usually gave bad results, and he therefore visited the station in November 1884, and after a careful examination of the instrument recorded his opinion that it would never work satisfactorily, and he desired that it should be dismounted and replaced by a self-registering anemograph of Beckley's pattern. An instrument of this description was therefore put in order, and was sent up early in March, and I was able to visit the station during the latter end of March 1885 to superintend its erection and starting. The Beckley's anemograph has now been set up, in a substantial manner, on the roof of a small house at the summit of Mount Vernon, the elevation of which is 7,599 feet. The anemograph is in a thoroughly satisfactory position as to exposure, and the instrument is one which always yields excellent results; and under the careful supervision of Messrs. Carter and Moore, it is to be expected that very valuable records will be obtained of the movements of the upper strata of the atmosphere, which will increase our knowledge of this branch of Indian meteorology in a manner hitherto unattainable.

The Berhampur observatory under Babu Mahendra Nath Roy and the Burdwan observatory under Babu Mokshoda Prosad Roy Chowdhury have continued to work in a highly satisfactory manner, and these observers have well maintained their previous reputation.

The Jessore observatory having improved very materially in its condition and in the character of its observations, the observer, Babu Paresh Nath Roy Chowdhury, has been recommended for a personal allowance of R5 per month. Hitherto the thermometers in the observatory were exposed in a wooden cage of the old pattern, but this has been replaced by a cage similar to those now used in our other observatories.

Gya observatory ceased to be furnished with radiation thermometers from 1882 by order of the Meteorological Reporter to the Government of India, as the breakages of these fragile instruments were more numerous than at other stations. I regret to have to report that there has been little or no improvement in the accuracy of the returns received from Gya. Mr. Eliot, in the Administration Report for 1883-84, hinted at the worthlessness of the minimum thermometer readings. He suspended the meteorological allowance of the Gya observer from 1st April 1884 for wrong readings of the minimum thermometer and for his not taking due precautions to find out the cause or source of the errors which had been pointed out to him more than once. A new minimum thermometer was then sent to the Gya observatory to replace the old instrument, in order to see if the defective readings were due to a bad thermometer, but the observer continued to give the readings from the indications of the old instrument. Another fresh cause of complaint was found in the readings of the anemometer. The observer was telegraphing wrong wind velocities, notwithstanding that his attention had been repeatedly called to the fact. Thereupon the office head clerk was deputed, in November 1884, to investigate into the cause of these erroneous readings, and he reported that he found the minimum thermometer which had been sent had remained in store with the spirit column broken, and that no report of the fact had been ever made, nor was the instrument ever used. The head clerk examined the old minimum thermometer and found it to be in good order, and this confirmed the belief that the observer had neglected his duties, and the wrong readings were mainly due to his want of attention to the regulations for reading the instrument. It had been the intention to take comparative readings, but this object was frustrated by the observer not bringing the new instrument into use, or reporting it as out of order, when a fresh thermometer could have been sent. The defect in the wind velocity readings was due to the observer's incorrect method of calculation in finding out the appropriate word from the code to telegraph his results. For these faults the observer was fined two months' pay. The observer, however, has since improved in his readings of the barometer, and it is hoped he will continue to furnish satisfactory readings of the rest of the instruments. If the observer fails in his duty in this respect, it will be a matter of question whether some other agency than the Civil Surgeon's clerk should not be sought for to carry on the duties of the observer.

The Akyab observatory has improved considerably in the character of its observations. The observer, however, had to be fined R10, in June 1884, for having broken a grass radiation

thermometer by plunging it into warm water. He had taken this step on the supposition that it would unite the broken column of spirit in the thermometer.

Having regard to the frequent breakage of nocturnal radiation thermometers at Cachar, the issue of these fragile instruments has been prohibited by the Meteorological Reporter to the Government of India, in accordance with the terms of his office circular No. 1, dated 3rd April 1882, with effect from November 1884.

Generally speaking, the returns from the rest of the observatories of the third class were satisfactory. The following are the reports of inspection of some of the observatories. Of the five observatories inspected, three, *viz.*, Datjeeling, Jessore, and Durbhanga, were visited by the Reporter, and two, *viz.*, Gya and False Point, by my head clerk.

Darjeeling was visited on the 28th November 1884. The barometer and thermometers were all in good order, except the dry minimum, in which a small portion of the column was detached. Instructions were given as to the method to remedy this permanently; but if the defect continues, it would be desirable to supply another instrument.

Jessore observatory was inspected on the 2nd December 1884. The barometer was in good order. The thermometer shed is not in a very satisfactory position, being much shut in. The instruments are all in good order. A slight encrustation was found on the wet bulb thermometer, and the observer was instructed to remove it in future. The solar radiation thermometer has a small portion of mercury lodging at the extreme end of the tube, which the observer allows for in his readings (adding 1·2°). The wind-vane and anemometer were in good order. The latter was on a shaky wooden pillar which was ordered to be replaced by a brick pillar of same height.

The observer took the readings of the instruments readily and correctly. As his observations have been found to be very satisfactory, the observer has been recommended for ₹5 special allowance.

Durbhunga observatory was inspected on the 8th October 1884. It was found to be in much better condition than on any of my previous visits. The thermometers were clean and in good order. The anemometer was found to be working satisfactorily. The wind-vane is a very heavy one, and should be replaced by a lighter one.

Gya observatory was inspected on the 21st October 1884. The barometer was in the same position as on last inspection and perfectly clean. The observer read the instrument correctly.

The shed thermometers were found to be perfectly clean. The graduations on the maximum and the wet minimum thermometers were obliterated.

The anemometer was found to be perfectly clean and in good condition, but it required to be fixed firmly on to the wooden platform.

The thermometer cage was shaky and required to be made firm, as there was likelihood of the readings being disturbed by a gust of wind.

The thatching of the shed was good, but some of the posts have been eaten up badly by white-ants, and may with advantage be replaced.

False Point observatory was inspected on the 14th February 1885. It is situated on an open maidan outside the Light-house compound. The thermometer shed is enclosed by a fence of lattice work. The radiation thermometers are exposed within the enclosure on their proper stands. The observatory required thorough repairs. The fencing and the posts require to be looked after much oftener to prevent the white-ants from causing injury. All the wood-work should be completely tarred.

The barometer was in the same position as on last inspection. The instrument was in perfect order and clean. It was quite vertical.

The cage instruments were all in good order and perfectly clean. The observer reported to me that the grass thermometer gave him much trouble, as the spirit column was found to break very often. I found, on inspection, that a part of the spirit about 2° in length remained lodged at about an inch and a half from the top end of the tube, and the instructions in the *vade-mecum* failed to unite it with the main column. This instrument should be changed.

The sun thermometer was found to have a break in the mercury column below the index. The instrument is of the Phillip's principle. The break was not noticed by the observer, but was set right again with slight effort. The separation was but little.

The anemometer is placed on a pillar 20 feet high. The instrument worked well, but apparently with friction.

The rain-gauge was in good order.

During my visit the observer, Mr. Workman, was ill, and so I had to inspect the observatory with his assistant, who also takes the readings. Mr. London read the instruments quickly and correctly.

The observatory, generally speaking, appeared to be one of the best kept stations in Bengal, and its neat condition testifies to the amount of interest and care taken by the observer in his work.

It may therefore be stated that the majority of these third class observatories are satisfactory in character, and the observations which have been received from them have on the whole been very reliable.

* * * * * * * * * *

Rain-recording Stations.—There has again been an increase in the number of rain-recording stations during the past year. The number of these stations during the past three years has been in 1882-83 162, in 1883-84 it was 167, and in 1884-85 it was 172. This increase is due to the establishment of the following rainfall stations in the Bancoora district:—

Indus, Kotulpore, Onda, Gangajalghatty, and Sonamukhi.

One station, however, *viz.*, Lalgola in the Moorshedabad district, has been suppressed at the latter end of March 1884, consequent on the abolition of the Government charitable dispensary, the rain-gauge having been in charge of the Assistant Surgeon. Efforts will, however, be made to re-establish it.

During the past year prominent attention was called to the fact that some parts of the province were very inadequately represented by rainfall-recording stations, and that Chutia Nagpur, in particular, only possessed 11 rain-gauges to represent no less than 26,966 square miles of country. To supplement the present registration system, and to extend the registration into districts which have hitherto been unrepresented, has been an urgent want of the department; and therefore, during the last part of the year, a scheme was drawn up, providing for no less than 72 additional rain-recording stations at an almost nominal cost to Government. The cost of nearly all the rain-gauges was met from the savings of this year's budget, and the annual cost will be simply the cost of the postage of the returns. With this extension, the system of registration will be fairly complete, and all parts of the province will be well represented. At the close of the official year the scheme was submitted to Government for sanction.

The returns from the great majority of the old recording stations were received punctually and regularly, and so far as can be judged, the registration of the rainfall is effected with fair accuracy and with considerable punctuality.

Instruments.—The following tables[1] show the number of instruments that have been broken or lost or rendered unserviceable during the year 1884-85 at the Imperial and Provincial observatories, and of the instruments supplied to them during the year. These tables show that the observers, on the whole, take great care in the use of the instruments committed to their charge, and the record may be looked upon as fairly satisfactory.

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Office Establishment.—The office establishment on the 31st March 1885 consisted of the following clerks:—

Babu Chandi Charan Chatterjee,	Head clerk.
,, Purna Chandra Mukerjee,	2nd ,,
,, Nibarun Chandra Chatterjee,	3rd ,,
,, Kamini Mohan Bose,	Tabulator.
,, Debendra Nath Banerjee,	,,
,, Joggeswar Roy,	,,
,, Bireswar Mukerjee,	,,
,, Jati Lal De,	,,
,, Rakhal Das Chackerbutty,	,,
,, Ashutosh Roy Chowdhuri,	,,
,, Hem Chandra Goswami,	,,
Haridas Mazumdar,	,,
,, Nagendra Nath Paul,	Draughtsman.

[1] The return of instruments issued has been incorporated in the general return in Appendix K.

The clerks generally have worked extremely well in dealing with the large amount of correspondence, and in the reduction and tabulation of the large number of observations now received, and with the preparation of reports which are required under the present system. The following are the regular reports and maps which are issued by the office :—

(*a*) The Bengal daily weather report, from about 15th May to the 7th of November, and the Bay of Bengal weather report, throughout the year.

(*b*) The weekly and monthly meteorological and rainfall reports for the province published in the *Calcutta Gazette*.

(*c*) Four sets of three rainfall charts monthly during the south-west monsoon period, 1884 (*i.e.*, from May to November), showing by colours—

(1) The actual distribution of rainfall for the same month.

(2) The variation of the actual from the average rainfall, indicating whether it was in excess or in defect, and the amount of such excess or defect.

(3) The variation of the actual from the average expressed as a percentage of the normal fall.

The four sets were all drawn and coloured by hand. One set was forwarded about the 8th of the succeeding month (to that to which it referred) to His Honour the Lieutenant-Governor; a second set to the Secretary to the Government of Bengal in the Revenue Department; a third to the Sanitary Commissioner; and the fourth was kept for office reference.

(*d*) Sets of tables giving the average and actual rainfall, and the difference between the actual and average rainfall (or variation) for each month of the year 1884, and for the whole year at 170 rainfall recording stations. These returns were published in the *Calcutta Gazette* of the 4th February 1885.

In addition to these a series of special returns and a series of special maps were prepared illustrating the distribution of the rains in Bengal during the south-west monsoon period of 1884, *i.e.*, from 15th May to 15th November. A short account of the distribution of the rains was also prepared. These were submitted to the Secretary to the Government of Bengal in the Revenue Department, and the special returns, together with the meteorological summary of the rains, were published with the resolution of Government dealing with the agricultural condition and prospects of the crops which appeared in the Gazette of the 19th November 1884.

These various reports necessarily entail a large amount of continuous and rapid work on the part of the office, and I have to place on record my appreciation of the zealous and intelligent manner in which the head clerk, Babu Chandi Charan Chatterjee, has supervised the work of the office, and has also performed the work of inspection. Babu Kamini Mohan Bose, who is in charge of the rainfall statistics, and Babu Debendra Nath Banerjee, who is in charge of the daily reports, have also done excellent service during the past year, and have maintained their reputation as hard-working and assiduous clerks. The clerks generally have worked most satisfactorily, and have thus enabled the returns to be published punctually and without a break throughout the year.

Storm Signals.—No very severe cyclone was generated in the Bay of Bengal during the year 1884, but a number of small cyclonic storms occurred during the south-west monsoon period. As usual, these small storms gave rise to strong winds and rough seas where they were generated over the Bay, and they brought heavy rainfall in their advance inland. These storms have all been noticed and their history briefly traced in the usual meteorological monthly summaries published in the *Calcutta Gazette*. Two small storms of this description were generated in June, both of which crossed the Balasore coast. In July six small storms were formed, five of which were generated over the sea, and of which three crossed the Balasore coast and two the Orissa coast between False Point and Gopalpore, while the sixth storm was generated over the land area, apparently in the Jessore district In August, two small cyclonic storms were generated, the first of which crossed the Balasore coast, and the second the Ganjam coast near Gopalpur. In September four depressions were formed, two over the land area and two over the sea, of which one crossed the coast near Chandbali, and the second between Gopalpur and Vizagapatam. In October two depressions were formed, one of which formed over the land, and the second, which was a large and shallow depression, formed in the centre of the Bay and advanced up the Bay in a northerly direction into Bengal, giving very heavy rain in its

progress. Most of these storms, however, were of comparatively small intensity, and it was not thought necessary to hoist the storm signals, except on two occasions, the first being on June 19th, and the second on July 10th. The signal which was hoisted on each occasion was the same, and signified that a small cyclonic storm would pass between False Point and Saugor Island, and the signals remained hoisted for about 24 hours for each storm, and with their passage inland the signals were lowered.

Daily Weather Reports.—The new form of the Bay of Bengal weather reports of the storm signal service has been continued this year with but slight modification. The reports were issued in blue and black instead of entirely in black, and advantage was taken of the establishment of an observatory at Midnapore and direct telegraphic connection with Jessore to add two more stations to the number of the stations sending observations for this report. The report, last year, furnished observations taken at 19 stations against 17 in 1883-84. An observatory has also been established at Burrisal, and the observations from this station will form a valuable addition to the existing number of stations on or near the coast of the Bay which furnish observations for the report. This report was supplied to 27 subscribers and 37 Government officials at the end of the year. The receipts for subscriptions during the year covered the cost of printing and distributing the reports. There was a small balance of ₹65-13-6 at the end of the year 1884-85, which was kept in hand in order to meet any repairs to the lithographic presses. The cost of printing the bi-color reports increased the expenditure on printing, and rather decreased the balance in hand during the year, but through the kind courtesy of Major Waterhouse the blue report forms are now being supplied to this Department from the Lithographic Branch of the Survey Department. Warm thanks are thus due to the Survey Department for assisting in the publication of these reports with neatness and despatch. The reports were published throughout the year without the break of a single day.

The Bengal daily weather reports, which were commenced in 1883, were published last year during the period May 16th to November 7th, 1884. The number of stations which furnished observations for this report during the year was 32, which is one in excess of the last year. These reports were published and issued by the Bengal Secretariat Press, and were supplied to 102 Government officials and to three subscribers. It appears, however, that the report is now appreciated by the mercantile community and by the general public, and it is hoped that the number of subscribers to the report will increase with each succeeding year. That such will be the case is probable from the fact that with the commencement of the 1885-86 reports no less than 15 new subscribers have registered their names. A little more practical value would probably be given to these Bengal weather reports, if the observations of the Assam stations could be included in them, and the meteorological condition of Assam and Bengal be discussed together in the review of the weather conditions daily, weekly, and monthly. But there are difficulties in the way of providing funds for the extra cost for the telegrams, &c., which may be necessary to give effect to these suggestions, and it is likely that the question may commend itself to the Assam Government for their consideration hereafter.

Copies of the weekly and monthly meteorological and rainfall returns (as published in the Gazette) were struck off for the convenience of the public, and were supplied at a charge just sufficient to cover the actual expense of printing and distribution.

Marine Meteorology.—The working of this department for the year remained entirely in the hands of Mr. W. L. Dallas, the scientific assistant to the Meteorological Reporter to the Government of India, so that no details can be given in the Bengal Administration Report as to the amount of work done and progress made in this branch of meteorological research. The returns sent in to the Indian Meteorological Office are, however, placed at the disposal of the Bengal Reporter, and the information has proved of much value in the preparation of special reports and accounts of various storms, the formation and history of which have been worked out by Mr. Eliot, and accounts of which have been published from time to time.

During the year, an exceedingly valuable memoir was drawn up by Mr. Eliot on the south-west monsoon storms generated in the Bay of Bengal during the years 1877 to 1881, which has since been published as Volume II, Part IV of the Indian Meteorological Memoirs. Mr. Eliot also drew up an account of the south-west monsoon storms of the 26th of June to 11th of July and of 10th to 15th November 1883. This paper was published in the Journal of the Asiatic Society of Bengal, Volume 53, Part II. A third valuable paper was also drawn up by Mr. Eliot on the cyclone which passed inland near Akyab on the 17th of May 1884, but up to the present time this paper has not been published.

Expenditure—The following statement gives the expenditure on account of the Bengal Meteorological Department during the year 1884-85, and the total grants sanctioned by Government under each of the various heads:—

Heads of Expenditure.	Actual expenses incurred during 1884-85.			Budget grant for 1884-85.		
	R	*a.*	*p.*	*R*	*a.*	*p.*
Meteorological Reporter's allowance	5,400	0	0	5,400	0	0
Office establishment	5,903	8	11	6,060	0	0
Office rent	1,300	0	0	1,300	0	0
Observers — Telegraph masters, &c.	2,630	0	0	9,960	0	0
Observers — Native observers	3,750	0	0			
Observers — Provincial observers	2,680	0	0			
Messengers' allowances	171	0	0	171	0	0
Allowances to Superintendents of observatories	1,440	0	0	1,440	0	0
Central Office.						
Contingent and office furniture	965	0	0	886	0	0
Purchase of rain-gauges for equipment of rain-recording stations under proposed extension.	840	0	0	.....		
Postage	1,478	1	3	2,730	0	0
Telegraphic messages	15,694	0	0	19,150	0	0
Travelling allowances	1,346	10	0	1,030	0	0
Observatories.						
Building and repairs	1,237	10	3	1,250	0	0
Contingent	75	13	6	98	0	0
Total	44,911	11	11	49,475	0	0

The expenditure of the department for the year 1884-85 has been considerably greater than in the year 1883-84, but this has been due to the fact that in the previous year, owing to unavoidable difficulties in starting the new scheme of provincial observatories, many of these did not commence work until the middle of June or beginning of July. The expenditure on observers' allowances, weather telegrams, &c., during the year 1883-84 therefore fell considerably short of the amounts which have been expended on these items during 1884-85, for the system has been practically in full working order during the whole of the year under review. The expenditure in the year 1884-85 has been R6,216-15-3 in excess of that of the previous year, and the main items of increased expenditure are those above alluded to. The expenditure has, however, been no less than R4,563-4-1 below the sanctioned budget grant for the year, but almost the whole of this difference is accounted for under the head of telegraphic messages or weather telegrams, and it will be noticed in the above statement that, with the exception of this item and that of postage, all other heads of expenditure are almost, if not quite, equal to the budget grants, notwithstanding that every endeavour has been made to keep the expenditure as small as possible. The expenditure on office rent has been rather larger than in previous years, but this is accounted for by the fact that in August last the office was removed into a larger house, and very much superior accommodation has been secured. The amounts under the two heads of expenditure in which savings are shown would not have been so large if it

were not that there had been delay in opening of one or two of the observatories, but with the full number of observatories which are now open, and with the extension of the rainfall registration which has been recently proposed, the margin for possible future savings in the budget grant of the department will be reduced to a very small figure.

The figures in the statement printed above give the total expenditure for the year as shown in the books of this office, but the statement does not include the cost of instruments supplied to the observatories by the Indian Meteorological Department, nor the cost of stationery supplied to the central office, nor the cost of printing the meteorological returns in the Gazette or otherwise, or of the forms required in the Meteorological Office, by the Bengal Secretariat Press.

A. PEDLER,

Offg. Meteorological Reporter to the Government of Bengal.

METEOROLOGICAL OFFICE, BENGAL;
The 15th June 1885.

APPENDIX B.

Extracts from the Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1884-85.

During the first half of the year under report the Department remained in charge of Dr. Murray Thomson, who was relieved by the permanent incumbent of the provincial reportership on the 21st of October. There was no change in the number or status of the observatories, which therefore, on the 31st March 1885, stood as follows:—

How maintained.	Class.			
	I	II	III	
By Meteorological Department.	Allahabad (in abeyance).	Allahabad.	Chakráta.	Benares.
		Lucknow.	Ranikhet	Sutna.
		Agra.	Pithoragarh.	Jhánsi.
		Roorkee.	Bareilly.	Sambhar
			Gorakhpur.	Ajmír.
By other Government Departments or public institutions.			Dehra.	Gházipur.
			Meerut.	Nowgong.
Voluntarily or by Independent States.	Jaipur.			

The third class observatory at Dehra continues to be efficiently maintained by the Survey of India, though now deprived of the supervision of the distinguished meteorologist (Mr. J. B. N Hennessey, F.R.S.) who long had charge of it, but is now retired from the service. The Meerut, Gházipur, and Nowgong observatories continue as heretofore to be supported by the Municipality, the Opium Factory, and the Rajkumar College of the three stations respectively.

First Class Observatories.

The fully-equipped observatory at Jaipur continued to do excellent work during the year. No new instruments were brought into use, but the meteorograph, Osler's anemometer and sunshine recorder furnished faithful automatic records, in addition to which the usual eye observations of the instruments in dicating temperature, pressure, and rainfall were punctually made. The observatory was inspected by me at the end of December, and found in excellent order, the only alteration I had to suggest being the removal of the sunshine recorder to a more exposed position. This change has since been effected. An extract from Dr. Hendley's report on the working of this observatory during the year 1884 will be found below (Appendix BI).

The first class observatory at Allahabad is still in abeyance, and the old observatory continues to rank in the second class. The additional observations at 4 A.M. and 10 P.M., and those of sunshine, cloud movements and ground temperature, mentioned in previous reports, have been made throughout the year.

The new observatory building at the Chatham Lines, sanction for which was obtained at the beginning of 1885, has made good progress under the superintendence of Mr. J. Heinig, Executive Engineer of the Division, and will probably be completed by November next. The plot of land assigned to the observatory, only an acre, is rather small to accommodate the observatory buildings and out-offices, and give a free exposure to the thermometers in the shed which was erected on the ground in a somewhat awkward position before the foundations of the buildings were marked out; but as on three sides the site is bounded by a wide open plain over which the wind meets with no obstruction, the observations made will probably be fairly representative of the district. Temperature observations at the new site were commenced in September, and will be discussed below.

Second Class Observatories.

The only one of these observatories, (besides that at Allahabad) inspected during the year, was Agra. At this station I found all the instruments clean and in excellent order, and there was every evidence that the observations were punctually and carefully made; but in the work of reducing the observations and in penmanship, the observer often exhibits signs of carelessness. Judging from the evidence of the registers, the Lucknow observer has worked carefully, punctually, and intelligently throughout the year, and the work of the Roorkee observer is now so much improved, that for the past year it has been nearly equal to that of the best observers in the province.

I am inclined to agree with what Dr. Thomson has said in last year's report about the disproportion between the amounts of work done by second and third class observers; but as the hourly observations, which constitute the heaviest part of the duties of observers at second class stations, have now been going on for nearly ten years, I think relief to the observers might be obtained by stopping them and reducing all the Government observatories, except Allahabad, to the third class.

Third Class Observatories.

Only two of these—Sambhar and Sutna—were inspected during the year. At Sambhar, one thermometer was found out of order, and the pad for the nocturnal radiation instrument was wanting. The observer, who is a native doctor in charge of several dispensaries at the salt works round Sambhar Lake, is frequently unvoidably absent from the station, and then his place is taken by his son. Both father and son seem intelligent, and can read all the instruments correctly, but the divided responsibility is probably not conducive to that careful handling of instruments and accuracy of observation which merits reward.

At the Sutna observatory, from which the Superintendent is absent nearly half the year, everything was found in good order except the Casella anemograph, which was working very stiffly, and owing to some fault of construction, has never run freely since first put up.

The other third class observatories, to judge from the returns sent in, have continued in their usual state of efficiency.

* * * * * * * * *

Special Observations.

As mentioned above, special observations of the duration of sunshine, by a modification of Campbell's sunshine recorder, and of the movements of the upper clouds by means of a nephescope, as well as of the temperature of the ground at various depths, were recorded at Allahabad and Jaipur.

* * * * * * * * *

The sunshine records for several days in July and August were lost owing to the removal of the instrument from the college to the tower mentioned in the report for last year. This tower has since been demolished in order that the materials might be incorporated in the new observatory building, and in the meantime the sunshine recorder has been replaced in its old position on the college roof, where the exposure is more complete than it was on the tower. In consequence of the removal to the tower, the percentage of bright sunshine during those months when the sky is most serene was apparently less than in former years.

The sunken thermometers continue to show that the mean temperature of the ground near the surface is about five degrees higher than that of the air. A more complete reduction of their readings will be attempted after the removal of the observatory to the new site, where, since the 1st January, observations of the ground temperature at the surface and at depths of 1, 3, and 9 feet have been made every day. The nephescope observations have been tabulated up to the end of March, but have not yet been published.

Since the 1st September, observations of shade temperature and humidity have been made at the new observatory site, Allahabad. As far as they go, these indicate that there is little difference between the daily maxima or minima at the two places, but that at 10 A.M. and 4 P.M. the new site on a large open plain is considerably warmer than the old, which is surrounded by trees. The humidity at the new site is considerably less than at the old.

As regards both temperature and humidity, these observations are confirmed by those formerly made at the Muir College, when it was purposed to establish the permanent observatory there. The observations of the radiation thermometers show that in the cold weather nocturnal radiation is much more effective at the new than at the old site, as was to be expected from its more open character, though there is no such difference in the minimum temperature of the air, because the old observatory lies in a hollow where the cold air accumulates at night.

Office and Office work.

As stated in the introductory paragraph, Dr. Murray Thomson held charge of the office up to the 21st October, when I returned from furlough. There was no change in the establishment of the office or of the Allahabad observatory, except the appointment from the 1st September of a temporary assistant to take observations at the new site. All the clerks and tabulators have worked well during the year, and the usual tabular statements and returns, as well as the permanent registers of the observations, have been punctually prepared.

The extra work completed during the year consisted of a paper on temperature and humidity observations at a height of 40 feet above the ground, at the new Calcutta Observatory, Alipore, prepared by me whilst acting as Meteorological Reporter to the Government of India, and a paper on the variations of solar radiation as computed from hourly observations of the black-bulb thermometer *in vacuo* at Lucknow. The former will be published in Vol. II of *Meteorological Memoirs* and the latter in the *Journal of the Asiatic Society of Bengal*. Some progress was also made with a comparison of the readings of the Fleming and Symons rain-gauges at numerous stations in the North-Western Provinces and Oudh. A short report on the subject has since been made to the Provincial Government. In this it is shown that whilst, at about half the stations, the readings of the old Fleming, or float-and-rod gauge, have been fairly accurate, at some of the others the error amounts to 20 per cent.; and that, on the whole, the proportion of erroneous gauges in the North-Western Provinces is less than in Oudh.

Cost of the Department.

The last appendix gives the usual statement of the cost of the Department for the year. The total cost for the office and the observatories situated in the North-Western Provinces and Oudh was ₹12,563-14-11, or ₹493-13-1 less than the previous year. The decrease was partly in contingent expenses, but chiefly in travelling allowance. Nothing was charged under this head during the year, the only inspections of observatories having been made by me when acting as Meteorological Reporter to the Government of India.

S. A. HILL,

Meteorological Reporter to Govt., N.-W. P and Oudh

APPENDIX B I.

Extract from Report on Observatory at Jaipur by SURGEON-MAJOR HENDLEY.

The observers have all worked well during the year and have shown an intelligent interest in their duties. Babu Durga Parshad is especially to be commended for his care of the meteorograph.

The Superintendent has again to thank Mr. Callaghan, the electrician, for his excellent services during the year, to which he would beg to draw the favourable attention of his own department.

Automatic Instruments.—The Osler's anemograph has been working throughout the year. It was set up in its present position on January 4th, 1881.

Meteorograph.—All the parts of this instrument, except the anemometer, were in order on December 31st. The traces have been good, as a rule; but, owing to weakness of the etching fluid employed to deepen them, a number of the plates have been spoiled. Surgeon-Major Hendley, when on his way to England on leave in July 1883, visited Mons. Schubart, the maker of the meteorograph, who resides at Ghent, and ordered new anemometer springs capable of resisting the extreme changes of temperature at Jaipur, and pointed out several slight changes which experience had shown him might be made with advantage in this beautiful instrument when constructed for use in a tropical climate. He was glad to find his observation coincided with those made by other observers. Finding also that the Meidinger battery, recommended in Mons. Van Rysslberghe's manual, gave more satisfactory results at Brussels than that in use at Jaipur, he ordered a complete one to be sent to India; but although eighteen months have elapsed, his order as yet remains unfulfilled. Surgeon-Major Hendley, in the hope of being able to discover an easier method of converting the traces of the meteorograph into figures than by measuring and tabulating, has tried to obtain average curves for each month for the thermometer and barometer by drawing the curves for each day on tracing paper over the points obtained from the zinc plates or over the plates themselves, the ends of ordinates having been first joined by a fine red ink line which could be clearly seen through the tracing paper.

Mr. S. Hill has examined the traces, and is of opinion that, the scale being very small, the line, which has to be tolerably thick to be visible, is itself nearly equal to two degrees on the thermogram, and so gives rise to a great error. Moreover, there is so much liberty of choice, that a good reliable mean curve cannot be satisfactorily drawn.

The writer agrees in this view, and regrets that a method which was suggested to him by the success of Galton's photographic mode of obtaining mean curves, to which it seemed at first in some respects superior for his purpose and more easy of practice, should have failed. For open curves, in which the divergence is not great, the results would probably be better.

Mr. Whipple's plan of drawing the curves for two days and then tracing between them a mean, which can be compared with other curves produced in the same way, takes up so much time that it is questionable whether it would not be preferable to measure and tabulate at once. The latter method, he is afraid, will have to be adopted.

Sunshine Recorder.—The sunshine recorder in use here is fitted with Professor Stoke's zodiacal frame, which enables far more accurate results to be obtained than with the older frame of the instrument.

Early in 1885 the instrument was removed from the open compounds to a pillar on the top of the anemograph tower, so that it might be at all times exposed to the sun.

The ordinary instruments have been in good order throughout the year.

APPENDIX BII.

Names of the Superintendents and of the Observers at the Meteorological Observatories in North-Western Provinces and Oudh during the year 1884-85.

Observatory.	Class.	Officer in charge.	Date. From	Date. To	Observers.	Date. From	Date. To
Allahabad	Second	Dr. Murray Thomson	1st April 1884	21st October 1884	Kedar Nath Chatterji, observer	1st April 1884	31st March 1885.
		S. A. Hill, Esq.	22nd October 1884	31st March 1885	Sasibhusan Banerji, assistant observer	Ditto	Ditto.
Agra	Ditto	Dr. A. H. Hilson	1st April 1884	15th May 1884	Mir Altaf Ali, observer	Ditto	Ditto.
		„ W. G. Robinson	16th May 1884	3rd August 1884	Abdul Majid Khan, assistant observer	Ditto	Ditto.
		„ A. H. Hilson	4th August 1884	3 st March 1885			
Lucknow	Ditto	„ J. Cameron	1st April 1884	15th November 1884	Chotay Lal, observer	Ditto	Ditto.
		„ J. C. Whishaw	16th November 1884	31st March 1885	Durga Pershad, assistant observer	Ditto	Ditto.
Roorkee	Ditto	Captain G. Onslow, R.E.	1st April 1884	4th November 1884	Chiranji Lal, observer	Ditto	Ditto.
		Dr. Murray Thomson	5th November 1884	31st March 1885	Jugmohan Lal, assistant observer	Ditto	31st May 1884.
					Ganga Ram, assistant observer	1st June 1884	31st March 1885.
Jeypur	First	Surgeon C. W. Owen, C.I.E.	1st April 1884	26th August 1884	Durga Pershad, observer	1st April 1884	Ditto.
		Babu Jadoo Nath De	27th August 1884	13th September 1884	Nathu Narain, assistant observer	Ditto	Ditto.
		Surgeon-Major D. N. Martin	14th September 1884	25th October 1884	Harbux, assistant observer	Ditto	3rd August 1884.
		„ T. H. Hendley	26th October 1884	31st March 1885	Sher Pertap, assistant observer	4th August 1884	31st March 1885.
Chakrata	Third	Captain A. E. Ward	1st April 1884	Ditto	Salig Ram	1st April 1884	14th December 1884.
					Ram Ruttun	15th December 1884	14th January 1885.
					Salig Ram	15th January 1885	31st March 1885.
Pithoragarh	Ditto	Rev. J. L. Humphry, M.D.	Ditto	31st December 1884	Sher Singh	1st April 1884	Ditto.
		Dr. S. Dease	1st January 1885	31st March 1885			
Ranikhet	Ditto	No Superintendent	...	...	Jewa Nund	Ditto	Ditto.
Dehra	Ditto	Depy. Superintendent, Survey of India	1st April 1884	31st March 1885	The head computers	Ditto	Ditto.
Meerut	Ditto	Dr. W. Moir	Ditto	Ditto	Harsaran Das	Ditto	Ditto.
Bareilly	Ditto	E. A. Phillips, Esq.	Ditto	Ditto	Jwala Pershad	Ditto	Ditto.
Gorakhpur	Ditto	Dr. T. H. Sweeny	Ditto	17th November 1884	Nizam-ud-din	Ditto	Ditto.
		„ C. Prentis	18th November 1884	31st March 1885			
Benares	Ditto	„ G. Thibaut	1st April 1884	Ditto	Babu Devakinandan Pattak	Ditto	Ditto.
Ghazipur	Ditto	„ P. A. Weir	Ditto	Ditto	„ Mahabir	Ditto	Ditto.
Sutna	Ditto	„ S. J. Goldsmith	Ditto	Ditto	Har Nath	Ditto	13th March 1885.
					Hira Lal	14th March 1885	17th March 1885.
					Har Nath	18th March 1885	31st March 1885.
Nowgong	Ditto	A. P. Mitchell, Esq.	Ditto	14th February 1885	Baldeo Parshad	1st April 1884	Ditto.
		John Mather, Esq.	15th February 1885	31st March 1885			
Jhansi	Ditto	Surgeon W. A. Simmonds	1st April 1884	30th November 1884	Kalka Das	Ditto	Ditto.
		Surgeon W. Moynan	1st December 1884	31st March 1885			
Sambhar	Ditto	F. Ashton, Esq.	1st April 1884	Ditto	Mr. J. Romare	Ditto	2nd May 1884.
					Habib-ul-la	3rd May 1884	31st March 1885.
Ajmere	Ditto	Dr. J. Croft	Ditto	21st November 1884	Ram Parshad	1st April 1884	Ditto.
		„ J. H. Newman	22nd November 1884	31st March 1885			

APPENDIX BIII.

Statement showing the expenditure of the North-Western Provinces Meteorological Department for the year 1884-85 (not including stationery, printing, or cost of instruments).

Station.	Imperial Services.			
	Establishment.	Contingencies.	Reporter's travelling allowance.	Total.
	R a. p.	*R a. p.*		*R a. p.*
Meteorological Reporter	2,999 15 11	.....	.....	2,999 15 11
Ditto Office	3,182 0 0	1,084 10 9*	.....	4,266 10 9
Allahabad Observatory	720 0 0	.....	.....	720 0 0
Ditto New Observatory	105 0 0	.....	.....	105 0 0
Agra Observatory	900 0 0	22 8 3	.....	922 8 3
Roorkee ditto	900 0 0	13 0 0	.....	913 0 0
Lucknow ditto	1,005 0 0	24 0 0	.....	1,029 0 0
Chakrata ditto	240 0 0	30 0 0	.....	270 0 0
Ranikhet ditto	300 0 0	.....	.....	300 0 0
Pithoragarh ditto	180 0 0	.....	.....	180 0 0
Bareilly ditto	180 0 0	.....	.....	180 0 0
Gorakhpur ditto	180 0 0	41 12 0†	.....	221 12 0
Benares ditto	240 0 0	.....	.....	240 0 0
Jhansi ditto	216 0 0	.....	.....	216 0 0
Total	11,347 15 11	1,215 15 0	.....	12,563 14 11

* Including office rent, charges for repairs to the observatories, and general contingencies of the Meteorological Office and Allahabad Observatory.

† Excluding charges for weather telegrams.

APPENDIX C.

Extracts from the Administration Report of the Meteorological Reporter to the Government of Punjab for the year 1884-85.

During the whole of the official year 1884-85 the Punjab Meteorological Department was under the control of my predecessor, Surgeon-Major E. Lawrie. My report is, therefore, compiled entirely from the office records at my disposal.

The more important incidents and particulars of the year under report are the following :—

1. In compliance with the expressed wishes of the medical authorities, and with the entire approval of the Meteorological Reporter to the Government of India, steps were taken towards the removal of the Lahore observatory from its unfavourable position in the compound of the Mayo Hospital to a far preferable one near the district jail. On the new site, one admirably adapted to the requirements of the Meteorological Department, is a suitable building set apart for meteorological purposes by the Government of the Punjab, and to it has been transferred the barometer which had been previously located in the Mayo Hospital. On an open space of ground at a short distance from the building, a thermometer shed has been erected, and has been fitted up with the usual instruments, and the spots where the rain-gauge and radiation thermometers are placed have been properly railed in. Observations have been taken at this new observatory since the 1st January 1885. In order, however, to ascertain the amount of change involved in the new arrangements and to secure the data necessary for a comparison between the results recorded at the old and those at the new sites (which are about 3 miles apart and very dissimilar in the character of the surroundings), the old thermometer shed near the Mayo Hospital has been retained as a *temporary observatory*, where observations are still taken as before. Such duplicate observations will, probably, be continued for a year or two and entail an additional monthly expenditure of ₹15-8.

2. During the year under report, a Beckley's anemograph was supplied to the Lahore observatory, but it has not been put up, as the tower required for its reception has not been erected. The Local Government, when addressed on the subject of the proposed tower, promised[1] to consider the matter in connection with the financial arrangements of the official year 1885-86.

3. The second class observatory at Ladakh, which was started primarily for actinometric observations, and which since its establishment in September 1871 had been under the Punjab Meteorological office, was transferred to the direct control of the Meteorological Reporter to the Government of India on 21st July 1884. The change referred to was considered desirable, because the actinometric observations taken at Ladakh were revised and calculated at Calcutta, and not in the Punjab office.

4. Besides those noted above no other important changes have been made in connection with the arrangements or management of the observatories under the Punjab Reporter, which were as follow at the close of 1884-85 :—

1. Lahore	2nd class observatory.	
2. Delhi	3rd	,,
3. Rawalpindi	,,	,,
4. Ludhiana	,,	,,
5. Murree	,,	,,
6. Sialkot	,,	,,
7. Simla	,,	,,
8. D. I. Khan	,,	,,
9. Mooltan	,,	,,
10. Sirsa	,,	,,
11. Peshawar	,,	,,

Of these it would appear that the observatories at Delhi, Rawalpindi, Ludhiana, Murree, Sialkot, Simla, and Sirsa were inspected by Dr. Lawrie during the year under report. This I gather from the

[1] Punjab Government's No. 3023, dated 2nd December 1884.

charges made on account of travelling allowances, but the results of the inspection are not known in the office. Dr. Lawrie has been requested to furnish particulars of the notes taken by him during his visits to the several stations. These when received will be submitted without delay, and may be treated as an appendix to this report. It would appear, however, that all the observatories worked satisfactorily, with the exception of that at Sialkot, in the reports of which numerous inaccuracies were detected, due probably to frequent changes in the observing staff.

5. The under-noted interruptions in the continuity of the meteorological observations in this province occurred during the year :—

Names of Observatory.	Dates on which observations were missed.	Remarks.
Murree . . .	24th May 1884. 29th July „ 6th September „ 6th October „ 13th „ „	The observer being on leave.
Rawalpindi . .	1st June 1884. 22nd August „ 23rd „ „ 10th September „ 12th „ „ 13th „ „ 8th October „ 5th November „	The observer being on leave.
Mooltan . . .	18th May 1884. 19th January 1885.	Ditto.
Simla	7th to 15th March 1885.	On account of the removal of the observatory.

* * * * * * * * * *

6. Up to the 31st December 1884 the office of the Meteorological Reporter was held in the building near the Government College previously used as a dâk bungalow. But on the 1st January 1885 it was transferred to the building already alluded to, situated near the Lahore district jail. The office in its new quarters enjoys ample accommodation, and was in excellent order when I assumed charge of it on the 10th April last, reflecting great credit upon the Head clerk Lalla Jasput Rai, a most efficient, intelligent, and painstaking man, who is also the chief observer at Lahore.

7. The following statements are attached :—

C.I.—Table showing the names of the superintendents and observers at the meteorological observatories in the province of Punjab during the year 1884-85.

[1] *CII.*—Return of instruments issued to each observatory in the province of Punjab in 1884-85.

J. CAMPBELL OMAN,
Meteorological Reporter for Punjab Government.

[1] Incorporated in Appendix K.

APPENDIX C I.

Table showing the names of the Superintendents and Observers at the Meteorological Observatories in the Province of Punjab during the year 1884-85.

No.	Observatory.	Class.	Names of Superintendents.	Period. From	Period. To	Names of Observers.	Period. From	Period. To	Allowances. Monthy Allowance.	Allowances. Meritorious Allowance.
1	Lahore	Second	Surgeon-Major E. Lawrie, Meteorological Reporter Punjab.	Throughout		Jasput Rai, chief observer Divan Chand, assistant observer	Throughout		20 10	5 5
2	Delhi	Third	Surgeon-Major G. C. Ross Ditto J. R. Taaffe Ditto G. C. Ross	1st April 1884 7th June ,, 7th July ,,	6th June 1884 6th July ,, 31st Mar. 1885	Bansee Dhar	Throughout		15	
3	Rawalpindi	Ditto	Surgeon-Major G. Massy Ditto J. Bannett	1st April ,, 3rd April ,,	2nd April 1884 31st Mar. 1885	Asst.-Surgeon Bhugwan Dass Ditto Elai Bukhsh Ditto Kalinauth Rai	1st April 1884 1st Jan. 1885 18th Feb. ,,	31st Dec. 1884 12th Feb. 1885 31st Mar. ,,	15	
4	Ludhiana		Brigade-Surgeon R. Rouse Asst.-Surgeon Bhugwan Dass	1st April ,, 26th Oct. ,,	25th Oct. 1884 31st Mar. 1885	Ditto Bhugwan Dass Ditto Miran Bukhsh Ditto Bhugwan Dass Ditto Brij Lall	1st April 1884 2nd June ,, 10th Sept. ,, 1st Dec. ,,	1st June 1884 9th Sept. ,, 30th Nov. ,, 31st Mar. 1885	15	
5	Murree	Ditto	Revd. Geo. C. Peake	Throughout		Mr. Cruickshank	Throughout		15	5
6	Sialkot	Ditto	Surgeon G. J. Shand Surgeon-Major E. Palmer Ditto J. C. Smith Ditto W. A. C. Roe Asst.-Surgeon Jowar Singh Surgeon-Major E. Palmer Asst.-Surgeon Sunder Mull	1st April 1884 23rd May ,, 22nd Sept. ,, 1st Oct. ,, 3rd Jan. 1885 16th Jan. ,, 14th Mar. ,,	22nd May 1884 21st Sept. ,, 30th Sept. ,, 2nd Jan. 1885 15th Jan. ,, 13th Mar. ,, 31st Mar. ,,	Asst.-Surgeon Sada Nand Ditto Jowar Singh Ditto Sunder Mull	1st April 1884 5th Dec. ,, 1st Mar. 1885	4th Dec. 1884 28th Feb. 1885 31st Mar. ,,	15	
7	Simla	Ditto	Capt. A. B. Fenton, Quarter-Master	Throughout		Sergeant J. J. Koings	Throughout		15	5
8	Dehra Ismail Khan	Ditto	Surgeon A. P. Holmes Ditto A. W. Mackenzie Ditto C. Macartie Ditto A. W. Mackenzie Ditto A. P. Holmes	1st April 1884 1st May ,, 6th Aug. ,, 21st Aug. ,, 25th Oct. ,,	30th April 1884 5th Aug. ,, 20th Aug. ,, 24th Oct. ,, 31st Mar. 1885	Noor Bukhsh	Throughout		15	
9	Mooltan	Ditto	Ditto T. R. Mulroney Pundit Jaswant Rai Surgeon T. E. L. Bate	1st April ,, 6th Jan. 1885 16th Jan. ,,	5th Jan. ,, 15th Jan. ,, 31st Mar. ,,	Wahid Ally	Throughout		15	5
10	Sirsa	Ditto	Apothecary R. Crossby	1st April 1884	1st Oct. 1884	Fazal Rahman Shivdyal	1st April 1884 1st Nov. ,,	31st Oct. 1884 31st Mar. 1885	15	
11	Peshawar	Ditto	Surgeon T. E. L. Bate Surgeon-Major J. M. Fleming Surgeon T. E. L. Bate Ditto W. Coates, M. D.	1st April ,, 1st Aug. ,, 16th Sept. ,, 8th Jan. 1885	31st July ,, 15th Sept. ,, 7th Jan. 1885 31st Mar. ,,	Kashi Ram	Throughout		15	5

J. CAMPBELL OMAN,
Meteorological Reporter to Government, Punjab.

APPENDIX D.

Administration Report of the Sanitary Commissioner, Central Provinces, for the year 1884-85.

I have the honour to submit the report on the working of the observatories in the Central Provinces for the year 1884-85.

2. The observatories remained the same as last year.

3. I have inspected all the observatories, except those at Seoni, Sambalpur, and Sironcha, since the submission of my last report.

4. *Nagpur.*—Inspected September 30th, 1884. All the instruments were found in good order, and the shed in good repair.

The observer was transferred to the office of the Deputy Surgeon-General on 22nd May, and the assistant observer promoted. The hospital assistant attached to the Central Jail (close to which the observatory is placed) being appointed assistant observer.

The present observer reads correctly, and is well reported of.

5. *Jubbulpore.*—Inspected October 22nd, 1884. The shed, which is not on the standard plan but with venetians all round, was in good repair, and the instruments in good order, except the following:—

(1) The anemograph, which was placed on the top of the Central Jail tower, had not worked for a long time, and was useless as it was; it has since been removed with the view of its being put in order, and set up: if placed on the jail tower, that structure will have to be altered to convert it round into a flat top.

(2) The minimum wet bulb thermometer read 4° lower than the hygrometer wet bulb. Mr. Hill inspected this observatory and gave a new scale of readings for this thermometer.

The observer reads correctly, and is well reported of, except that he is occasionally unpunctual.

6. *Pachmarhi.*—Inspected October 18th, 1884. The thermometer shed had been lately blown down; a new one was under construction, and was finished on 1st December. The thermometers were, while the shed was being built, placed in the room with the anemograph, a brick building usually kept closed.

The observer was found extremely careless in the way he read the barometer, his carelessness necessitating the rejection of the registers kept by him; he was fined by your orders.

7. *Chanda.*—Inspected October 9th, 1884. The shed and instruments were in good order, except that the wind-vane was surrounded by trees higher than itself; it has since been removed to an open space, a new pillar having been built for it.

Shed in good order. The observer is well reported of.

8. *Saugor.*—Inspected January 30th, 1885. The shed is not of the standard pattern, but surrounded with venetians. The palings require renewal.

The grass radiation thermometer in place of being placed on a pad, as directed, was exposed on a bare board.

The solar radiation thermometer had a small piece of the mercury detached and fixed at the upper end of the tube.

The observer was well reported of, and read correctly; he exchanged places with the man at Hoshangabad in February. Two rain-measure glasses were broken.

9. *Seoni.*—The thatch of the shed was renewed. The observer is well reported of.

10. *Hoshangabad.*—Inspected January 9th, 1885. The palings of the shed were in bad repair.

The solar radiation thermometer had a small piece of the mercury detached and fixed at the top of the tube.

The observer was well reported of as regards his observatory work, but his conduct was not quite satisfactory; he exchanged stations with the observer at Saugor.

One solar radiation thermometer was broken.

11. *Khandwa.*—Inspected December 8th, 1884. The shed and instruments were found in very good order.

The observer is well reported of.

12. *Raipur.*—Inspected November 18th, 1884. The shed is old; a new one will be constructed this year. The instruments were all in good order, but the wind-vane is placed rather low.

13. *Sambalpur.*—The observer, who had hitherto been favourably reported of and was in the receipt of an extra allowance, was detected in recording readings which were impossible.

The thermometer readings of the instruments in the old observatory also appeared to have been entered all wrongly, so that the registers had to be rejected.

One solar radiation thermometer was broken.

14. *Sironcha.*—New posts and ladder to the anemometer were supplied during the year. The readings of the barometer were found untrustworthy, and the registers had to be rejected.

The Superintendent of the Chanda observatory was requested, at his visit to Sironcha, to carefully inspect the instruments, and test the fitness of the observer for his post. The Superintendent's report was that the instruments were in good order, but the eye of the observer not quite on the proper level when reading the barometer, and that he could read correctly.

15. The usual statements of instruments issued from this office, and of the names of superintendents and observers, are appended.

16. To obviate the difficulty hitherto experienced in getting a man fitted to take the place of an observer going on leave, or falling ill, an additional assistant observer on R10 per mensem was sanctioned by the Government of India in September 1884.

17. A suitable man has been entertained and trained at the Nagpur observatory, to which he will be attached when not elsewhere required.

JAMES H. LOCH, M.D.,
Deputy Surgeon-General and
Sanitary Commr., Central Provinces.

Names of Superintendents and Observers at the Meteorological Observatories in the Central Provinces during the year 1884-85.

Observatory.	Class.	Officer in Charge.	Date. From	Date. To	Observer.	Date. From	Date. To	Remarks.
Nagpur	Second	Surgeon-Major R. T. Wright, M.D.	1st April 1884	23rd April 1884	T. V. Allagheri Swamy	1st April 1884	22nd May 1884.	
		Surgeon-Major J. F. Barter	24th April ,,	11th July ,,	P. Soobiah	23rd May ,,	31st Mar. 1885.	
		Surgeon-Major R. T. Wright, M.D.	12th July ,,	31st March 1885	P. Soobiah, assistant observer	1st April ,,	22nd May 1884.	
					Hospital Assistant Abid Hussain, assistant observer	23rd May ,,	9th Nov. ,,	
					Hospital Assistant Mohamed Abdul Rahimon	10th Nov. ,,	19th Mar. 1885.	
					Hospital Assistant Abid Hussain	20th Mar. 1885	31st Mar. ,,	
Jubbulpore	Ditto	Brigade-Surgeon W. R. Rice, M.D.	1st April ,,	1st May 1884	Sudhuram Dubey, observer	1st April 1884	31st Mar. ,,	
		Surgeon-Major R. T. Wright, M.D.	2nd May ,,	3rd July ,,	Hospital Assistant Mohun Lal, assistant observer	1st April ,,	16th April 1884.	
		Brigade-Surgeon W. R. Rice, M.D.	4th July ,,	31st Mar. 1885	Hospital Assistant Koonji Behari Lal, assistant observer	17th April ,,	6th July ,,	
					Hospital Assistant Ram Lagan Sing, assistant observer	7th July ,,	31st Mar. 1885.	
Pachmarhi	Ditto	R. Obbard, Esq., Asst. Commr.	28th [1]April ,,	30th June 1884	Pandit Kesho Rao, observer	1st April ,,	31st Mar. ,,	
		Surgeon-Major Turton, A.M.D.	1st July ,,	25th Aug. ,,	Lachmon Rao, assistant observer	1st April ,,	31st Dec. 1884.	
		Surgeon-Major Drury, A.M.D.	26th Aug. ,,	31st Mar. 1885	M. Venketachellum, assistant observer	1st Jan. 1885	31st Mar. 1885.	
Saugor	Third	Surgeon-Major E. O. Tandy	1st April ,,	27th Nov. 1884	Deen Dyal	1st April 1884	19th May 1884.	
		Surgeon-Major Boalth	28th Nov. ,,	31st Mar. 1885	Narain Rao	20th May ,,	23rd Feb. 1885.	
					Jadunath Bose	24th Feb. 1885	31st Mar. ,,	
Hoshangabad	Ditto	Surgeon-Major Browne	1st April ,,	22nd April 1884	Jadunath Bose	1st April 1884	19th Feb. ,,	
		Surgeon Armstrong	23rd April ,,	23rd July ,,	Hospital Assistant Govind Vittal	20th Feb. 1885	28th Feb. ,,	
		Surgeon Warlike	24th July ,,	22nd Dec. ,,	Narain Rao	1st Mar. ,,	31st Mar. ,,	
		Surgeon Henderson	23rd Dec. ,,	31st Mar. 1885				
Khandwa	Ditto	Surgeon-Major Cullen, M.D.	1st April ,,	31st Mar. ,,	Behari Lal Purasar	1st April 1884	31st Mar. ,,	
Seoni	Ditto	Surgeon-Major Gaffney	1st April ,,	31st Mar. ,,	Punchan	1st April ,,	31st Mar. ,,	
Chanda	Ditto	Assistant Surgeon Shib Chunder Bhattacharji	1st April ,,	31st Mar. ,,	Seetaram	1st April ,,	31st Mar. ,,	
Sironcha	Ditto	Narahar Govind, Tehsildar	1st April ,,	3rd Oct. 1884	Hospital Assistant P. Muthu Krishna Naidu	1st April ,,	31st Mar. ,,	
		Runga Rao ,,	4th Oct. ,,	3rd Jan. 1885				
		Narahar Govind ,,	4th Jan. 1885	31st Mar. ,,				
Raipur	Ditto	Brigade-Surgeon Trimnell	1st April 1884	31st Mar. ,,	Kishen Rao	1st April ,,	31st Mar. ,,	
					Sham Soonder Das	1st April ,,	14th Mar. ,,	
Sambalpur	Ditto	Honorary Surgeon-Major Harrison	1st April ,,	14th April 1884	Hospital Assistant Syed Mohamed Hyder Hussein Hydari	15th Mar. 1885	31st Mar. ,,	
		Surgeon Collington	15th April ,,	21st May ,,				
		Honorary Surgeon-Major Harrison	22nd May ,,	31st Nov. ,,	*Additional Observers for special duplicate readings.*			
		Surgeon Collington	1st Dec. ,,	8th Jan. 1885				
		Honorary Surgeon-Major Harrison	9th Jan. 1885	11th Feb. ,,	Syed Mohamed Hyder Hussein Hydari	1st April 1884	13th April 1884.	
		Surgeon Poynder	12th Feb. ,,	31st Mar. ,,	Shurresh Chunder Ghose	14th April ,,	15th Oct. ,,	

[1] From 1st to 27th April 1884 no superintendent.

APPENDIX E.

List showing the names of the Superintendents and Observers at the Meteorological observatories reporting immediately to the Office of the Meteorological Reporter to the Government of India during the year 1884-85.

Observatory.	Class.	Names of Superintendents.	Period. From	Period. To	Names of Observers.	Period. From	Period. To
Aden	Second	Major F. M. Hunter, Bo. S. C.	1st April 1884.	31st March 1885	Walter Abraham, observer	1st April 1884.	31st March 1885.
					B. C. Cordeiro, assistant observer	1st April ,,	31st March ,,
Bushire	Third	Lieutenant-Colonel E. C. Ross, C.S.I.	1st April ,,	31st March ,,	Mr. D. A. F. Azivedo	1st April ,,	16th Nov. 1884.
					Mr. A. Paes	17th Nov. ,,	31st March 1885.
Quetta	Ditto	Surgeon J. C. Fullerton, M.B.	1st April ,,	15th April 1884	A. Samuel Pillay	1st April ,,	31st March ,,
		Ditto R. T. Baker, M.B.	16th April ,,	16th July ,,			
		Ditto J. C. Fullerton, M.B.	17th July ,,	31st March 1885			
Leh	Second	B. Rowland, Sergeant, R.E.	1st April ,,	31st March ,,	Suss Kagah, observer	1st April ,,	31st March ,,
					Hashmat Ali, assistant observer	1st April ,,	31st March ,,
Chamba	Third	J. Hutcheson	16th Sept. ,,	16th Dec. 1884.	Barkhurdar Khan	16th Sept. ,,	31st March ,,
Kailang	Ditto	Revd. A. W. Heyde	1st Sept. ,,	31st March 1885	T. Dana	1st April ,,	31st March ,,
Pachpadra	Ditto	G. A. Bradford	1st April ,,	10th April 1884.	Rashbehari Ghosh	1st April ,,	5th June 1884.
		G. Scully	11th April ,,	9th July ,,	Moorat Lall	20th July ,,	6th Oct. ,,
		G. A. Bradford	10th July ,,	31st March 1885	Gopal Chundra Banerji	7th Oct. ,,	29th Oct. ,,
					Moorat Lall	30th Oct. ,,	31st March 1885.
Mussooree	Ditto	Rev. Fr. Benedict	1st April ,,	31st March ,,	.....	.....	.....
Katmandu	Ditto	...	...	.....	Mohamad Hussain	1st April 1884.	13th Jan. 1885.
					Pashupat Sharan Sinha	14th Jan. 1885.	13th March ,,
					Mohamad Hussain	14th March ,,	31st March ,,
Pedong	Ditto	Revd. A. Desgodins, S.J.	1st Feb. 1885.	31st March 1885	Rev. A. Desgodins, S.J.	1st Feb. ,,	31st March ,,
Mongpoo	Ditto	.....	.....	....	George A. Gammie	1st April 1884.	31st March ,,
Makhla	Ditto	J. Balantine	1st April 1884	31st March 1885	Papannah	1st April ,,	31st March ,,
Diamond Island	Ditto	..	.....	.....	F. W. Marsh	1st April ,,	31st July 1884.[1]
Port Blair	Ditto	Surgeon-Major J Reid, M.B.	1st April 1844	24th April 1884.	J. T. Peters	1st April ,,	31st March 1885.
Nancowry	Ditto	Ditto W. N. Keefer	25th April ,,	31st March 1885	Roop Sing Rana	1st April ,,	7th July 1884.
					Shaik Kobeeruddeen	8th July ,,	21st Jan. 1885.
					S. Thomas	22nd Jan. 1885.	31st March ,,

[1] The observatory was in abeyance since this date.

APPENDIX F.

Extracts from the Administration Report of the Meteorological Reporter for Western India for the year 1884-85.

The work of the Meteorological Department of Western India has been carried on nearly in the same manner as in the previous year. Mr. A. N. Pearson, A.I.C., F.C.S., F.R. MET. S., continued to act as Meteorological Reporter for Western India up to the 10th November 1884, when I reverted to the office. No new observatories have been established, but the one at Zanzibar has unfortunately been closed, just at the time when there seemed a good prospect of the observations being turned to useful account for the purpose of forecasting the general character of the rainy seasons in India. It was hoped that the observations might have been continued under some arrangement with the authorities of the English Foreign Office, to whom the administration of British affairs at Zanzibar had been transferred from the Government of India, and, as a temporary measure, the observer from India was allowed to remain at the station. He was recalled, however, at the end of September 1884, and the observations were afterwards recorded, whenever possible, by Dr. Williams, the Agency Surgeon; but on the untimely death of that officer in December 1884, the registrations ceased and have not since been resumed. Mr. E. E. Sawyer, Chief Engineer and Agent of the Western India Portuguese Guaranteed Railway, has established an observatory at Mormugao in connection with the harbour works there. The observatory is furnished with a large Robinson-Beckley anemograph and a large standard observatory barometer by Casella, as well as with various thermometers. Since the 1st October 1884, Mr. Sawyer has very kindly telegraphed the 10 A.M. readings of the various instruments to the Bombay office, and still continues to do so. The observations are thus made available for the purposes of the storm-warning service, and in return for the assistance thus rendered, any information at the disposal of the office as to atmospheric disturbances which may possibly cause rough weather at Mormugao is communicated to Mr. Sawyer by telegraph.

The observatories sending registers to the Bombay Meteorological Office during the year may be classified as follows:—

Province.	Second class.	Third class.
		Jacobabad.
		Hyderabad.
	Karachi	Bhuj.
	Deesa	Rajkot.
Bombay Presidency	Poona	Surat.
	Belgaum	Malegaon.
		Sholapur.
		Ratnagiri.
		Karwar.
Rajputana	.....	Mount Abu.
		Bickaneer.
Central India	.....	Neemuch.
		Indore.
		Amraoti.
Berar	.....	Akola.
		Chikalda.
		Buldana.
Malabar Coast	.....	Calicut.
Africa	.....	Zanzibar.

There are in all four observatories of the second class and nineteen of the third class. At each of them two sets of observations are recorded daily, and at the second class stations hourly observations are also recorded on four days in each month. There are also more than four hundred stations at which the daily rainfall is regularly recorded, but these are not under the supervision of the Meteorological Department. Copies of the registers of the daily rainfall at these stations are furnished annually to this office, where they are preserved for future reference.

Appendix F I contains a list of the observatories, and shows the names of the superintendents and of the observers who have held office during the year.

Meteorological Buildings.—A new fence has been made at Hyderabad for the radiation thermometers and rain-gauge. The thatch of the thermometer shed at Karwar has been renewed. New outer shutters have been fitted to the small windows of the anemometer tower at Deesa, and a new iron ladder has been made to provide easy access to the anemometer. The trap door in the roof of the tower has also been altered to secure greater convenience and safety. These are the only changes of any importance that have been reported to the Bombay Office.

Instruments and their verification.—The following table[1] shows what instruments have been issued during the year. They were all verified by comparison with the standard instruments before being despatched to their destinations.

There is not a single instance of a breakage in the first six columns of the table. This speaks well for the general carefulness of the observers, and also proves that the breakages shown in the next two columns are mainly due to the conditions of exposure.

* * * *

The large Robinson-Beckley anemographs at Deesa and Belgaum have given nearly continuous traces throughout the year; that at Deesa was out of action for seven days in all, and the one at Belgaum for five days. The Belgaum traces are somewhat imperfect, from the 18th December 1884 to the 8th January 1885, on account of some instrumental derangement, but I think it will be possible to tabulate the data satisfactorily. The Casella anemograph at Poona has been out of action on six days, and that at Ratnagiri on one day, when the instrument was dismounted and cleaned. The traces of these two instruments are, however, faulty on all days when the wind was calm.

In my report for the year 1880-81, I pointed out how very variable the direction of the wind is at Deesa, in the day hours during the dry weather. The traces of the Belgaum anemograph show that the same phenomenon obtains at that station also, and there is little doubt that it obtains generally at all inland stations. This fact throws great light on the nature of the "hot winds," and shows them to be mainly due to the small atmospheric whirl-winds which are the direct effect of solar radiation, not to corresponding variations of the barometric gradients between widely separated stations. The standing difficulty in the theory of these winds, *viz.*, that they are not accompanied by such barometric gradients as are always observed in the case of convection currents, is thus removed, and it also becomes clear why that component of the diurnal variation of the wind velocity, which is due to these winds, should vary in the same manner as the solar radiation, a fact which I long ago pointed out in my paper on the winds of Karachi. Any theory of the "hot winds," which does not carefully distinguish between that part of the motion which is due to the atmospheric whirls and the small residual part which may be a true convection current, must therefore be unsound.

Training of Observers.—The observers whose names are given below finished a course of training in the Bombay Office on the dates specified. Most of them were appointed to observerships at the stations placed opposite to their names. The two last were trained at their own request in the hope of being able to fill future vacancies.

Minguel Fernandez	1884	April	5th	Karachi.
S. K. Gadgil	„	July	10th	Mount Abu.
Bulwant Luxman	„	„	12th	Sholapur
G. C. Moodliar	„	October	28th	Rajkot.
Chhaganlal Harilal	„	November	12th	Surat.
Shaik Mahomed	„	„	„	Malegaon
Shunkerji Naronji	1885	March	25th	Bhuj
Devji Mulloo	1884	July	16th.	
Bhan Vithoji	„	August	21st.	

[1] Incorporated in Appendix K.

Most of these young men were trained to fill the observerships formerly held by Military Hospital Assistants, the services of the latter as meteorological observers having been dispensed with chiefly because of the interruptions of the meteorological work caused by their frequent transfer from one station to another on military duty. It has yet to be seen whether the alternative plan of appointing, on a low rate of pay, youths who have no other duty to perform will work well. One of them has already left his post without permission.

Character of the work of the Observers.—As in previous years, the observations recorded by trained and experienced observers are accurate and trustworthy; but in those instances where untrained and inexperienced men have been employed, there are, as a rule and for a time, imperfections in the observations. The observations recorded at Jacobabad, Bickaneer, Karachi, Deesa, Indore, Rajkot, Surat, Akola, Chikalda, Poona, Sholapur, Ratnagiri, Belgaum, Karwar, and Zanzibar appear to be thoroughly trustworthy throughout the year, but some of those recorded at Hyderabad, Bhuj, Mount Abu, Neemuch, Amraoti, Buldana, and Malegaon have, for a short time, been unreliable, either from erroneous observation or faulty manipulation of the instruments. However, even at these latter stations, by far the greater portion of the work has been satisfactorily performed.

The following statement shows all cases of total interruption of the records for more than a day or two, but it does not include partial interruptions arising from derangements or breakages of instruments. With the exception of these interruptions, and one presently to be mentioned, the observations may be regarded as practically continuous at all the twenty-three stations.

List of Interruptions of the Observations.

Station.	Date.	Cause of Interruption.
Jacobabad	From 1884 November 30th to 1884 December 4th	Observer sick.
Bhuj	„ „ September 10th „ „ September 15th	„ „
„	„ „ October 1st „ „ October 15th	No observer.
Mount Abu	„ „ June 9th „ „ June 30th	„ „
Sholapur	„ „ April 1st „ „ May 4th	„ „
„	„ 1885 February 8th „ 1885 February 17th	Observer sick.
Karwar	„ 1884 April 19th „ 1884 April 22nd	„ „
Zanzibar	„ „ September 3rd „ „ September 15th	Observatory closed temporarily.

The observations recorded at Zanzibar are fragmentary from 1884 October 1st to December 24th, and the observatory was closed on the date last named, in consequence of the illness and subsequent death of Dr. Williams.

Storm Warning Service.—This service has been carried on as in previous years. Daily telegrams are received from eight stations on the west coast of India, and from three on the Coromandel coast. They do not furnish sufficient data to make it possible to draw satisfactory weather charts, and hence anything like a complete view of the meteorological conditions of the area which is supposed to be protected cannot be obtained from the daily reports. To remedy this deficiency in some measure, the office is empowered to call for special reports from additional stations whenever the regular daily reports show that a disturbance is in existence; but the time lost in calling for, preparing, and sending in these reports causes the information to be of but little value.

* * *

Cautionary telegrams were sent to various ports as shown in the following table, but no orders to hoist the storm signals were issued during the year:—

Names of Ports.	Dates of cautionary telegrams.
Karachi	22nd June, and 8th and 9th September.
Bhavnagar	22nd June, and 8th September.
Daman	22nd June, and 8th September.
Bombay	21st November.
Ratnagiri	21st „
Vingorla	21st „
Karwar	21st „
Kumta	21st „

* * * * * * * *

Inspection of Observatories.—Twelve of the observatories have been inspected during the year, namely, those at Surat, Deesa, Mount Abu, Neemuch, Indore, and Malegaon by Mr. Pearson, and those at Poona, Sholapur, Ratnagiri, Belgaum, Karwar, and Karachi by myself. I also visited the observatory at Goa, which is maintained by the Portuguese Government, and the one at Mormugao which has been established by Mr. Sawyer. The condition in which Mr. Pearson found the observatories inspected by him was described in his report for last year. The results of my own inspections are given below.

Poona.—Most of the instruments were in good order, and all appeared externally to be clean and well kept. The inner surface of the glass jacket of the sun thermometer seemed slightly dimmed, and one side of the inner surface of the barometer cistern was dirty, but as the other side was clean and the zero point could be accurately adjusted, I did not disturb the instrument. I compared the barometer and thermometers with the portable standard instruments, and obtained the results shown in the following table of errors. On testing the orientation of the wind vane, I found it to be one point out of position, the index pointing to south by east when the vane was pointed to south. This change appears to have been due to the gradual lengthening of the chains, which connect the vane to the recording apparatus. To remedy the defect, I lowered the slab on which the lower portion of the instrument rests, and re-adjusted the index and embossing arrows to correspond with the position of the vane. The hole in the slab, through which the clock pendulum passes, was at the same time enlarged, to prevent contact of the pendulum with the slab. On the whole, the instrument has worked as well as can be expected, considering the faulty principle on which it is constructed.

Sholapur.—The observer at this station appears to be a painstaking man, but his education is defective, and I doubt his capability of understanding the instruction book. The instruments were all clean and in a serviceable condition, but there were several small defects which a more intelligent man would have rectified. The iron pipe which supports the anemometer had worked somewhat loose, and the flag for observing the wind direction was made of a small piece of stiff strong cloth, instead of a long piece of thin soft cloth which would be easily moved by light winds. The instruments in the thermometer cage were all clean and in good order, but a broken bottle containing a reserve supply of water for the wet bulb thermometers was found inside the cage. The results of my comparisons of the instruments with the portable standards are given in the following table.

Ratnagiri.—The observer at this station, Mahadev Cuddum, is one of the best in Western India. Everything was in good order. The anemograph was dismounted and cleaned during my visit. A few links of one of the chains were removed, and the instrument was re-adjusted. The instruments were all compared, as usual, with the standards, and the results are given in the table of errors.

Belgaum.—I inspected this observatory in January 1885, and found most of the instruments in good order, but the woollen material which forms the pad for the nocturnal radiation thermometer had almost all disappeared, and had not been renewed. The large Robinson-Beckley anemograph was, to all outward appearance, in good order, but the traces showed many instances of peculiar change of wind direction, which led me to suspect that the movements of the vane were being opposed by a considerable amount of friction. Accordingly, with the aid of a highly intelligent mechanic who was found on the spot, I completely dismounted the instruments, and it was then found that both sets of friction wheels were so much clogged with rust and dirt that they would not turn. Every part was thoroughly cleaned, clock and recording apparatus included, and afterwards remounted and re-adjusted. An improvement was also made by removing several slack pins from the connecting tubes, and substituting screw clamps for them.

Karwar.—At this observatory all the instruments were in good order, and everything was clean and tidy. On taking comparative readings of the barometer and the portable standard, I noticed, however, that the zero adjusting screw did not work well, and on opening the cistern I found the plunger had worked loose from its embedded female screw. It was temporarily fixed with sealing wax.

Karachi.—The only defects at this observatory were that the small inverted cup at the top of the shaft of the anemometer had worked loose, and that the observatory clock had stopped, the obvserver keeping time by his own watch. The loose cup had been fastened temporarily, however, by inserting a layer of thin muslin, and it has since been properly re-soldered. In all other respects

the observatory was in very good order. The observer at this station has occasionally been some days late in sending in his registers, but latterly I have had no cause to complain of such negligence.

Alterations of the errors of the Instruments.—The following table shows the alterations that have taken place in the errors of the various instruments between the time when the errors were first determined and the time of the last inspection, the sign + meaning that the index error has risen the sign — that it has fallen :—

Stations.	Barometer.	Thermometers.					
		Dry bulb.	Wet bulb.	Dry maximum.	Dry minimum.	Wet minimum.	Grass minimum.
	Inch.	°	°	°	°	°	°
Poona . . .	—·005	+0·1	+0·1	+0·2	0·0	—0·4	—0·5
Sholapur . . .	+·006	+0·2	+0·2	+0·2	+0·1	—0·7	—0·1
Ratnagiri . .	—·004	+0·3	+0·5	+0·1	0·0	—0·5	0·0
Belgaum . . .	—·006	+0·1	0·0	+0·3	—0·2	—0·4	+0·4
Karwar . . .	—·006	+0·5	—0·2	+0·4	—0·4	—0·4	—0·6
Goa . . .	+·001	+0·1	+0·3	+0·1	+0·1	+0·7	+0·7
Karachi . . .	—·005	+0·2	0·0	+0·1	—0·1	—0·2	+0·1

Office Establishment.—At the end of the year the office establishment stood as follows :—

Name.	Monthly pay.
	R
For Land Meteorology.	
Ganesh Sadashiv	60
Vajeram Iccharam	45
Mahadev Ramchandra	40
Krishnaji Ram Chandra	30
Ramchandra Sadashiv	30
For Storm Warning Service.	
Govind Sitaram	30
Anant Vishvamber	30

There are also two servants each on ₹10 per mensem.

The number of clerks for land meteorology is the same as it was in 1877. * * * * *

Library.—One-hundred and twenty-seven books and pamphlets have been presented to the library during the year. They have all been entered in the catalogue, which now contains 951 works on meteorology and allied subjects.

Work of the Bombay Office.—As in previous year, the work of the office has consisted almost exclusively of the correction and reduction of the observations from the nineteen third class observatories; the careful examination of the corrected and reduced observations of the four second class observatories; the curving and checking of the observations of all the observatories; the training of observers; the determination of the errors of all the instruments issued; and the carrying on of the correspondence, &c. The monthly tabular returns, showing the daily, half-monthly, and monthly results, as well as all the individual observations, have been regularly and punctually forwarded to the office of the Meteorological Reporter to the Government of India about six weeks after the close

of the month in which the observations were made, and monthly abstracts of results have been published in the *Bombay Government Gazette*. Copies of the registers of daily rainfall in the year 1883 from 408 stations have been collected, and those not already written out in English have been translated from the vernaculars in which the originals were kept. Copies of the registers of the daily rainfall at a number of stations during many past years have been made for the Meteorological Reporter to the Government of India by clerks temporarily engaged for the purpose. Some special calculations, which had for their object the elucidation of discrepancies in the abnormal variations of barometric pressure at certain stations, have also been made.

Special Work.—A brief sketch of the meteorology of the Bombay Presidency for the year 1883-84 was prepared by Mr. Pearson for incorporation in the Administration Report of the Government of Bombay. Mr. Pearson's paper entitled "Some results of an examination of the barometric variations in Western India" has been published *in extenso* in the Quarterly Journal of the Royal Meteorological Society for October 1884, and an abstract of his description of a new component anemograph, invented by himself, appeared in the number for January 1885. Mr. Pearson has also written a note on the rainfall of Northern India, which was published in the Journal of the Asiatic Society of Bengal. A note by myself on Mr. Blanford's theory of the winter rainfall of Northern India has also appeared in the November number of the journal. This note excited some adverse criticism from Messrs. Blanford and Eliot, to which I was invited to reply. I did so early in December last, but have not as yet seen the reply in print.

In conclusion, I thankfully acknowledge the services gratuitously rendered by the superintendents of the observatories. They have cordially given me all the assistance in their power.

APPENDIX FI.

Names of the Superintendents and of the Observers who have officiated at the Observatories in Western India during the year 1884-85.

Station.	Class.	Superintendent.	Period. From	Period. To	Observer.	Period. From	Period. To	Remarks.
Karachi	Second	Surgeon D. O'Sullivan	1st April 1884	11th April 1884	Narayen Vinayek	1st April 1884	9th April 1884.	
		Brigade-Surgeon C. H. Gerand	12th April ,,	31st Mar. 1885	Minguel Fernandez	10th April ,,	31st Mar. 1885.	
					Hassan Kadar (assistant)	1st April ,,	31st Mar. ,,	
Deesa	Ditto	Surgeon-Major F. Lyons	1st April ,,	13th Aug. 1884				
		Surgeon P. J. Damania	14th Aug. ,,	28th Sep. ,,	Ramkrishna Keshav	1st April ,,	31st Mar. ,,	
					Dayal Bhala (assistant)	1st April ,,	31st Mar. ,,	
		Surgeon-Major F. Lyons	29th Sep. ,,	5th Nov. ,,				
		No Superintendent	6th Nov. ,,	30th Nov. ,,				
		Surgeon-Major W. P. Bridges	1st Dec. ,,	1st Jan. 1885				
		Ditto A. Barry	2nd Jan. 1885	14th Jan. ,,				
		No Superintendent	15th Jan. ,,	12th Mar. ,,				
		Surgeon-Major W. P. Bridges	13th Mar. ,,	31st Mar. ,,				
Yerrowda (Poona)	Ditto	Ditto S. M. Salaman	1st April 1884	31st Mar. ,,	Narayen Sakharam	1st April ,,	31st Mar. ,,	
					G. C. Moodliar (assistant)	1st April ,,	19th Oct. 1884.	
					C. S. Moodliar (ditto)	20th Oct. ,,	31st Mar. 1885.	
Belgaum	Ditto	Ditto R. P. Ferguson	1st April ,,	28th Feb. ,,				
		Ditto R. Harmon	1st Mar. 1885	22nd Mar. ,,	Ramchandra Datta	1st April ,,	31st Mar. ,,	
					Keshav Hari (assistant)	1st April ,,	30th Sep. 1884.	
					Shantaram Wassudev (assistant)	1st Oct. ,,	31st Mar. 1885.	
		Ditto W. J. Campbell	23rd Mar. ,,	31st Mar. ,,				
Jacobabad	Third	Surgeon B. N. Koyaji	1st April 1884	31st Mar. ,,	Babaji Rawoot	1st April ,,	25th Nov. 1884.	
					Shaik Ali	26th Nov. ,,	31st Mar. 1885.	
Bickaneer	Ditto	No Superintendent	.....	.....	Ram Lal	1st April ,,	31st Mar. ,,	
Hyderabad (Sind)	Ditto	Surgeon-Major H. M. Macbeth	1st April 1884	1st Mar. 1885	V. E. Nazareth	1st April ,,	30th Sep. 1884.	
		Surgeon H. W. Stevenson	2nd Mar. 1885	21st Mar. ,,	Ramparsad Mohunsing	1st Oct. ,,	9th Nov. ,,	
		Surgeon-Major R. M. Craig	22nd Mar. ,,	31st Mar. ,,	Bhuraya Jullaya	10th Nov. ,,	24th Feb. 1885.	
					S. Pais	25th Feb. 1885	31st Mar. ,,	
Bhuj	Ditto	Surgeon W. A. Barren	1st April 1884	*16th July 1884	Ganu Luxman	1st April 1884	16th June 1884.	*Approximate dates. † Ditto date.
		Surgeon-Major W. Atkins	*17th July ,,	†16th Sep. ,,	Gulabkhan	17th June ,,	30th Sep. ,,	
		Surgeon W. A. Barren	17th Sep. ,,	15th Oct. ,,	No observer	1st Oct. ,,	14th Oct. ,,	
		Surgeon-Major F. Jones	16th Oct. ,,	31st Mar. 1885	Solomon Ezekial	15th Oct. ,,	31st Mar. 1885.	
Mount Abu	Ditto	Ditto C. White	1st April ,,	5th Mar. ,,	Bapalal Mehta	1st April ,,	31st May 1884.	
		Ditto R. H. Robinson	6th Mar. 1885	31st Mar. ,,	J. Whittenbury	1st June ,,	16th July ,,	
					S. K. Gadgil	17th July ,,	31st Mar. 1885.	

Names of the Superintendents and of the Observers who have officiated at the Observatories in Western India during the year 1884-85—contd.

Station.	Class.	Superintendent.	Period. From	Period. To	Observer.	Period. From	Period. To	Remarks.
Neemuch	Third	Surgeon-Major H. Staunard	1st April 1884	30th June 1884	T. Bachu	1st April 1884	31st Mar. 1885.	
		Surgeon C. E. Nichol	1st July ,,	23rd Jan. 1885				
		Surgeon-Major E. C. R. Ward	24th Jan. 1885	31st Mar. ,,				
Indore	Ditto	Ditto D. F. Keegan	1st April 1884	31st Mar. ,,	Trimbakrao	1st April ,,	31st Mar. ,,	
Rajkot	Ditto	Surgeon S. T. Avetoon	1st April ,,	17th Feb. ,,	Keshav Gobind	1st April ,,	31st Oct. 1884.	
Surat	Ditto	Surgeon-Major S. B. Haliday	18th Feb. 1885	31st Mar. 1885	G. C. Moodliar	1st Nov. 1884	31st Mar. 1885.	
		Ditto J. Robb	1st April 1884	19th April 1884	Dhunjibhai Motabhai	1st April ,,	14th May 1884.	
		Ditto H. Atkins	20th April ,,	7th July ,,	Luxminarayan	15th May ,,	15th Nov. ,,	
		Ditto S. O'B. Banks	8th July ,,	31st Oct. ,,	Chhagaulal Harilal	16th Nov. ,,	31st Mar. 1885.	
		Ditto H. Atkins	1st Nov. ,,	2nd Mar. 1885				
		Ditto S. O'B. Banks	3rd Mar. 1885	18th Mar. ,,				
		Ditto H. A. Lewis	19th Mar. ,,	31st Mar. ,,				
Akola	Ditto	Surgeon J. J. Moran	1st April 1884	25th May 1884	Samuel Gregory	1st April ,,	31st Mar. ,,	
		Ditto R. B. Roe	26th May ,,	26th Aug. ,,				
		Ditto J. J. Moran	27th Aug. ,,	31st Mar. 1885				
Amraoti	Ditto	Ditto T. Hume	1st April ,,	31st Aug. 1884	Bukaram Pandurang	1st April ,,	9th May 1884.	
		Ditto R. B. Roe	1st Sept. ,,	6th Nov. ,,	S. Narsappa	10th May ,,	9th June ,,	
		Ditto T. Hume	7th Nov. ,,	31st Mar. 1885	Bukaram Pandurang	10th June ,,	2nd Dec. ,,	
					S. Narsappa	3rd Dec. ,,	25th Mar. 1885.	
					Bukaram Pandurang	26th Mar. 1885	31st Mar. ,,	
Chikalda	Ditto	Ditto K. James	1st April ,,	19th April 1884	Hiralal	1st April 1884	31st Mar. ,,	
		Ditto W. Hendricks	20th April ,,	18th July ,,				
		Ditto R. James	19th July ,,	31st Mar. 1885				
Buldana	Ditto	Apothecary D. Callaghan	1st April ,,	31st Mar. ,,	Shunker Ramrao	1st April ,,	6th May 1884.	
					Keshav Apaji	7th May ,,	6th Aug. ,,	
					Shunker Ramrao	7th Aug. ,,	28th Feb. 1885.	
					Mahomed Husen	1st Mar. 1885	31st Mar. ,,	
Malegaon	Ditto	Surgeon W. P. Carson	1st April ,,	15th Dec. 1884	Solomon Aaron	1st April ,,	12th April 1884.	
		No Superintendent	16th Dec. ,,	31st Mar. 1885	Piraji Jadhav	13th April ,,	8th Sept. ,,	
					G. C. Moodliar	9th Sept. ,,	12th Sept. ,,	
					Piraji Jadhav	13th Sept. ,,	14th Nov. ,,	
					Shaik Mahomed	15th Nov. ,,	31st Mar. 1885.	
Sholapur	Ditto	W. R. Scroggie, Esq., L.R.C.P.	1st April ,,	31st Mar. ,,	Guljar Sing	1st April ,,	7th April 1884.	
					Govind Narhar	8th April ,,	16th July ,,	
					Balvant Luxman	17th July ,,	31st Mar. 1885.	
Ratnagiri	Ditto	Surgeon H. McCalman	1st April ,,	31st Mar. ,,	Mahadev Cuddum	1st April ,,	31st Mar. ,,	
Karwar	Ditto	R. G. C. Westbrook, Esq.	1st April ,,	31st Mar. ,,	G. W. M. D'Aranjo	1st April ,,	31st Mar. ,,	
Zanzibar	Ditto	Surgeon J. Williams	1st April ,,	23rd Dec. 1884	Abdur Rehman	1st April ,,	30th Sept. 1884.	
					Surgeon J. Williams	1st Oct. ,,	23rd Dec. ,,	
					Observatory closed	24th Dec. ,,		
Calicut	Storm-warning service.	Captain H. Richardson	1st April ,,	26th May ,,	F. D. Rozario	1st April ,,	12th Oct. 1884.	
		T. W. Barboza, Esq.	27th May ,,	4th July ,,	G. G. Ragooloo	13th Oct. ,,	17th Oct. ,,	
		Captain F. M. Gillham	5th July ,,	31st Mar. 1885	F. D. Rozario	18th Oct. ,,	31st Mar. 1885.	

APPENDIX G.

Extract from the Administration Report of the Meteorological Reporter to the Government of Madras for the year 1884-85.

The separation of the Madras Meteorological Office from the Madras Astronomical Observatory, which had been in contemplation for some time, took place on the 15th of January 1885, when the office was temporarily transferred to a small building in the Nungumbankum High Road; but, as the accommodation was insufficient, the office was again removed in May to a larger house, situated in Spur Tank Road, Egmore. This change necessitated an application to Government for sanction of a small monthly allowance for office rent, which was readily granted. The increase in the number of observatories under my administration, as also of the establishment; the contribution of books to the library; a larger supply of meteorological instruments in store, and the general increase of the work of the department during the last four years, rendered it essential for the Madras Meteorological Office to have better accommodation than could be provided at the Astronomical Observatory, and hence its transfer.

As a copy of the complete meteorological register, kept at the Madras Observatory, is regularly furnished to this office by the Government Astronomer, no proper thermometer shed has yet been erected, but a cage and complete set of instruments for learners is always at hand; and during the year under report, three assistants were taught to take meteorological observations, one of whom was appointed to Kurnool in September last.

Eleven of the observatories were inspected during the year, the remarks on which will appear under the headings of their respective stations.

Appended to this report are the usual tables showing the list of officers in charge, and assistants, &c., lists of instruments supplied and in store, and the expenditure of the department during the official year 1884-85. The list of instruments supplied is considerably larger, owing to the new observatory started at Rajahmundry and the increased number of the stations inspected. No changes were made in the time of taking the observations.

The following is a complete list of the observatories which furnish meteorological registers:—

Madras.	Cuddapah.	Negapatam.
Amini Divi.	Kurnool.	Rajahmundry.
Bangalore.	Madura.	Salem.
Bellary.	Mangalore.	Secunderabad.
Cochin.	Masulipatam.	Trichinopoly.
Coimbatore.	Mercara.	Wellington.

Amini Divi (Laccadives).—Since the appointment of the new assistant Syed Laul, there has been a decided improvement in the observations taken at this station; but owing to the interruption of communication with the Island during the south-west monsoon, the records from April to November did not reach the Madras office until January 1885.

On reduction of the observations the work proved satisfactory, and I anticipate better results in future from this observatory. It appears, however, that the assistant, who is a medical subordinate, had to go to Mangalore on the 26th of December 1884, where he was detained until the 22nd of April 1885, and as there was no one else in the Island able to read the instrument during his absence, the meteorological register had to be discontinued.

As soon as communication with the Island is re-established, I hope to make arrangements that will ensure the continuity of the observations, when the assistant is unavoidably absent on circuit duty. The inaccessibility of the Island for regular inspection is a great disadvantage, but an occasional visit does not seem to be an impossibility.

The thermometer shed was re-thatched, and the instruments appear to have been in fair order throughout the year.

Bangalore.—This observatory was inspected on the 18th of April 1884, when a teakwood thermometer cage, similar to those supplied to all the other stations, was substituted in the place of the open

board hitherto in use. The barometer was clean and in very good order, and the small room in which it is placed, being utilized entirely as a meteorological office, enables the assistant to work there undisturbed.

The thermometer shed is well situated on a nice open piece of ground in the hospital compound. The thatching was in fair condition, but there were open spaces of about 8 inches both above and below each of the side screens, and the framework of the shed and surrounding railings required painting: these defects were immediately rectified. The wet bulb thermometer was thickly coated with a deposit of lime, and though clean, and apparently in good order, the re-arrangement of the instruments in the cage necessitated my changing the dry and wet bulb, the maximum, and the dry and wet minimum thermometers.

A complete list of instruments supplied to the observatories of the Madras Presidency during the year, with the dates on which they were first used, will be found on pages ... and ... of this report.[1]

The Casella anemometer supplied in September 1882 was working well, and the rain-gauge and sun and grass thermometers were properly placed and in good order.

The office records have been neatly and carefully kept, and the whole condition of the observatory was very satisfactory, reflecting credit upon the medical officer in charge and his assistant. The register was continuous throughout the year, and the observations were correctly reduced by the assistant, and forwarded to the Madras office a few days after the end of each month. In consequence of the increased accommodation required at the Bowring Hospital, the medical authorities applied to me to transfer the meteorological observatory to some other part of Bangalore; but after a considerable amount of correspondence on the subject, no convenient site seemed available, so the instruments have been allowed to remain in their old position.

The work of this observatory has been so steady and trustworthy since its commencement in November 1867, that it would be very undesirable to remove it, unless it is absolutely necessary.

Bellary.—The work of this second class observatory, consisting of the ordinary observations three times a day, *viz.*, at 10h., 16h., and 22h.; hourly observations on four days in each month, and the synoptic observations taken at the local time corresponding to 7 A.M. Washington mean time for the "United States International Weather Bulletin," was carried on steadily throughout the year, without any change in the instruments. The anemometer was out of order from the 5th to the 8th of October, and on the 13th of November 1884 it became quite useless and was taken down. With this exception, all the instruments were in good condition.

The two assistants have conducted their duties in a creditable manner, reducing their observations more accurately than in past years; but notwithstanding fines, the records and reductions have been withheld from the Madras office till three or four months after date. The probable transfer of the observatory to a better and more suitable site (mentioned in the last report) was unavoidably delayed, and until this change has been effected inspection has been deferred.

Cochin.—The observatory at this station was inspected on the 23rd of March 1885. The barometer occupies a very good position as regards light and safety on the southern wall in the Brigade-Surgeon's private office, but the mercury in the cistern was in a very oxidized state, the inside of the glass being coated round with a greenish film about half an inch deep. The brass scale and vernier were very discoloured, rendering it difficult for the assistant to see the divisions. I was unable to change the instrument as my store of barometers at Madras was exhausted; but when a new one has been procured, it will be well to have readings of both instruments taken hanging side by side, to enable us to ascertain any error caused by this defect.

The thermometer shed had just been painted, and was in excellent condition; the only imperfection being spaces of about 6 inches above instead of below each of the side screens; this was soon altered. The situation of the shed is favourable in many respects, although perhaps a little too much enclosed by the surrounding hospital buildings. The thermometers were clean and faultless, but on removing the board on which they had always been placed and erecting a cage instead, a re-arrangement of the instruments was necessary, and as the dry and wet bulb thermometers had not had their corrections verified for some years, I thought it a favourable opportunity for making a complete change. The only thermometer allowed to remain was the sun maximum, which was supplied in March 1882. I found the anemometer, as I expected, only about 16½ feet high, sheltered by higher buildings and surrounding trees. There are eight tall casuarina trees towering above every-

[1] Incorporated in Appendix K.

thing else in the hospital compound, not far from the observatory, and I suggested having one cut, and placing the instrument on the top, with a good strong ladder, to enable the assistant to take the readings; but the medical officer in charge showed me how hollow all the trees were, and as one had only very recently been blown down, he thought it would not be safe. There are no high buildings anywhere about Cochin, and the only place that the medical officer could recommend was the flag-staff in the Municipal Gardens. To place the instrument there, permission will have to be obtained of the Port Officer at Cochin, or of the Master Attendant at Madras; this will not be a difficult matter, and I hope soon to have the anemometer recording reliable measurements of the velocity of the wind at this station.

The rain gauge is placed in the hospital compound instead of within the enclosure as at most other observatories; it was in good order.

A very necessary addition to this observatory is a neat and useful fencing enclosing the shed, instead of the unsightly bamboos tied together to do duty for rails. The medical officer in charge promised to send me an estimate of the probable cost of wooden railings, but on receipt of it I found that for about the same price Messrs. Oakes & Co. of Madras would supply all that was needed, *viz.*, three rows of barb fencing posts and turn stile. This fencing is a sure preventive against cattle straying into the shed enclosure, a very necessary precaution at most of the well-kept observatories where the green grass around and the thatching on the roof of the shed are great temptations to the animals outside. No grass minimum thermometer has been in use owing to there not being any in store at Madras. The records of all the other instruments were continuous throughout the official year.

The assistant is careful and accurate in his reductions, and his work has reached the Madras office in good time each month. The general condition of the observatory was very satisfactory and creditable to the medical officer in charge and his assistant; none of the defects noted being attributable to any carelessness.

Coimbatore.—As the thermometer shed had just been painted and repaired when I inspected the observatory on the 18th of March 1885, I found it in excellent condition. No change had been made in the positions of the instruments since my last visit, and they were all in very good order.

A very necessary improvement at this observatory is a good high staging for the anemometer and wind vane, as there is no convenient building anywhere of a sufficient height near on which these instruments could be placed, and their positions of about 14 feet from the ground cannot afford reliable results.

The official records and papers belonging to the observatory were in good preservation. There have not been any breaks in the records throughout the year, and the assistant has reduced his observations accurately, and forwarded them to me punctually every month.

In consequence of the good service rendered by the assistant, his retirement has been deferred until the 31st of May 1885.

Cuddapah.—The thermometric observations were commenced at this new observatory on the 23rd of March 1884; but as there were no serviceable barometers, nor sun and grass thermometers on hand at Madras, I had to await the arrival of a fresh supply from Calcutta. On receipt of the instruments, I sent my head clerk in charge of a barometer and two radiation thermometers, which were brought into use on the 11th of April 1884. On placing the barometer in the observatory, Vythinathe Iyer found it in good order; but judging from the telegraphic readings received at Calcutta, the Meteorological Reporter to the Government of India informed me that, when compared with neighbouring stations, they appeared to be too low. A set of comparisons with the Madras Meteorological Office standard barometer will therefore be necessary, and I intend sending the head clerk there again as soon as possible.

The grass minimum thermometer had only been in use for six days when it was found broken, and on the 15th of September, when the observer went to read the instruments, the dry bulb of the hygrometer was missing; a search was immediately made, and the thermometer was found broken outside the hospital compound, evidently done out of sheer mischief. As the shed is in rather a public position, and there does not appear to be any one to guard the hospital compound, it was considered advisable not to use either sun or grass thermometers until better arrangements could be made for the safety of these instruments when exposed.

The assistant was fined for inattention to orders, but more particularly for troubling the Meteorological Reporter to the Government of India on matters regarding the observatory, which should have

been reported to the Madras office; the latter was a most inexcusable act of insubordination. A few extra posts had been sent to the observatory, and it was the duty of the assistant to have carried out the instructions received from my office, and to have kept the shed in proper order; instead of which he delayed the erection of the posts, and let the side screens fall into a state of dilapidation. I also desired the assistant to have a lock and key put to the cage, but this was not attended to. On the 17th of September the Madras Meteorological Office peon was sent to Cuddapah with a new dry bulb thermometer, and with instructions to stay there until he had seen the shed and fencing properly repaired.

The records have been continuous throughout the year, and the assistant appears to have taken the observations carefully.

The anemometer and wind vane have not been erected yet, owing to the difficulty of getting a suitable staging and ladder.

Kurnool.—It is with regret that I have to report that the work of this observatory was perfectly useless and unreliable until the appointment of a new assistant on the 21st of October 1884.

When I inspected the station on the 27th of August, I found the barometer clean, in good condition, and well placed, but it had been removed from its original position in the Telegraph Office to the signaller's room in the Post Office, on the amalgamation of the two departments. On asking the Post Master, who was also meteorological assistant, to set the barometer and take a reading, I found that, instead of adjusting the ivory point so that it nearly touched the mercury in the cistern, he thoroughly immersed it, and in setting the vernier, he left a complete line of light between it and the surface of mercury in the tube. I showed him exactly how to set the barometer and read the vernier, and after a little practice he improved. He was very willing and anxious to learn, but he said he could not possibly undertake to record an anemometer, as his combined duties of Postal and Telegraph Master were too much. I informed him that the anemometer must be erected as soon as possible, and that under the circumstances his best plan would be to resign the office of meteorological assistant, as he had already applied to me to be allowed to do. After a little reluctance however, he complied, and on my return to Madras, a new assistant was sent to take charge. No change had been made in the position of the shed since its erection, but it was in a very unsatisfactory state; the thatching on the roof only being about an inch and a half thick, and as there were no side screens, the thermometers were unsheltered from sunshine or rain. The muslin of the wet minimum thermometer was also very discoloured, evidently through impure water; but with this exception the remaining instruments were in fair order. I asked the Executive Engineer of the District to have the shed properly repaired, which he did soon after my visit. Owing to difficulties regarding a convenient position and platform for the anemometer, this instrument has not been put up. The sun maximum thermometer was found broken in October, and the readings of the dry maximum thermometer were erroneous in December. These instruments were therefore replaced by new ones.

As the Collector of Kurnool has very kindly offered to undertake the superintendence of the observatory, it is under consideration to remove the instruments to the Collectorate. I hope this change will be speedily carried out, as it will ensure satisfactory results in future.

Since the appointment of G. R. Paramaswara Iyer, there has been a great improvement, and the observations have been reliable.

Madura.—The Madura observatory was inspected on the 10th of March 1885. The surface of the mercury in the cistern of the barometer was in a state of oxidization, and required cleaning; but with this exception the instrument was in a fair condition.

The thermometer shed occupies a favourable position; it was well thatched and the side screens were properly fixed with spaces below to admit air. The dry and wet bulb thermometers required re-verification of their corrections, and most of the other thermometers were old but clean and in good order. The erection of a teakwood thermometer cage in the place of the board rendered it a favourable opportunity for changing the thermometers, which was accordingly done, with the exception of the sun maximum and grass minimum, which had only been lately supplied. The outer glass of the former instrument was very scratched, and the divisions on the latter thermometer were rather indistinct. The glass bottle and rain measure, belonging to the rain gauge, were both cracked.

I strongly objected to the untidy state of the compound in which the shed is situated, as being overgrown with shrubs, weeds, and high grass, it must in a measure obstruct the free circulation of the air. The assistant promised to have the grass cut and the compound cleared and made neat. The

anemometer and wind vane were in good positions and working order. The medical officer in charge was away when I visited the observatory, and the permanent assistant was also absent on sick leave. Generally speaking, when any of the highly paid assistants required leave, they have made arrangements with some one on the spot to carry on the duties; but V. Sashachellum Naidu has not done so, and I have been obliged to send assistants from the Madras office on two occasions, which has caused delay and great inconvenience at head-quarters.

The wet bulb thermometer was broken on the 9th of April 1884, and owing to there not being any on hand at Madras, I could not replace it until September. Breakages of instruments at this observatory, causing omissions in the records, have been a frequent source of complaint, and I think it has been partly due to carelessness. The assistant has not performed his duties as satisfactorily as I could have wished, owing probably to ill health which will very likely oblige him to retire before long.

Mangalore.—This station calls for no special remark beyond a few words of praise at the highly creditable way in which the Telegraph Master in charge of the observatory has conducted his meteorological duties throughout the year.

No new instruments have been required. The shed has been repaired when necessary, and the records have been forwarded to the Madras Meteorological Office with the greatest punctuality.

Masulipatam.—Continuous observations have been carried on at this observatory throughout the year; and with the exception of the barometer, the instruments appear to have been in fair order. The abnormally low barometric readings, when compared with those of past years and other stations, threw suspicion on the new instrument, and necessitated early inspection. As I had occasion to send my head clerk to Rajahmundry, it was a favourable opportunity for him to inspect the Masulipatam observatory, which he did on the 3rd and 4th of May 1884. He found the thermometers in good order, with the exception of the wet bulb of the hygrometer, the muslin and thread of which had evidently not been changed for some time.

On checking the records made by the assistant, Vythinathe Iyer found that they were carefully and accurately made; and the only conclusion arrived at concerning the barometer is that it must have got out of order during transit from Calcutta. Having asked Mr. Blanford to send me a new one, I hoped it would have reached Masulipatam before my head clerk left; but it did not arrive until the 16th of June, when it was immediately brought into use. Its readings appear to be correct.

The assistant only partially reduced his observations, and even the few months' registers that he attempted were not forwarded to the Madras Meteorological Office till about six months afterwards, when the work had been done by my office staff. Failing sight was his excuse, and this has since been confirmed by the medical officer in charge, who has reported him unable to see small figures. He has only been allowed half pay throughout the year, and his immediate retirement is necessary.

Mercara.—Everything at this station has been perfectly satisfactory throughout the year. The instruments appear to have been in good order. The observations have been carefully and accurately taken by the Telegraph Masters who have been in charge of the observatory, and the records have been forwarded to the Madras office with the greatest regularity. The thermometer shed was repaired before the commencement of the monsoon, and notice given that before long nearly all the posts will require renewing, an estimate for which was also forwarded. From information received lately, it seems under contemplation to amalgamate the Postal and Telegraph Offices, in which case the observatory will probably have to be removed.

Negapatam.—The barometric readings were unaccountably erroneous for some time; and as there were no good instruments in store at Madras, the Meteorological Reporter to the Government of India supplied a new one from Calcutta, which was brought into use on the 1st of August 1884. The wet bulb thermometer was reported useless from the 14th September 1884, and was replaced by another on the 16th of the same month.

A teakwood thermometer cage, similar to those in use at other observatories, was sent to Negapatam at the request of the medical officer in charge, who superintended its erection, and saw the instruments properly arranged. I inspected the observatory on the 13th of March 1885, and recorded the following remarks:—The position and condition of the barometer were all that could be desired. The thermometer shed occupies a good open position in the hospital compound. The side screens required moving to the centre of the shed, and raising a few inches at each side to shield the thermometers, and the telegraph wires enclosing the shed were a little slack.

These small requirements were immediately attended to. In every other respect the shed was in very good preservation. The thermometers were clean and in fair order, but old ; and as I wished to have some of their corrections re-verified, I took this opportunity of changing all but the sun maximum and grass minimum thermometers. As the tube of the latter instrument had been reported cracked, a new one had been sent, but it was broken in transit ; so on returning to Madras I despatched another, which has been in use since the 23rd of March 1885. The anemometer was in good order, but the letter S had come off the wind vane.

The Negapatam meteorological office in which the barometer is kept, and the assistant works, is exceedingly clean and tidy. The office records are neatly bound, and arranged on a small shelf put up for the purpose, and a fresh copy of Mr. Blanford's rules had just been procured and hung up.

The assistant has reduced his observations accurately and neatly throughout the year, and the registers have always reached me in excellent time.

The condition of the Negapatam observatory was most satisfactory and highly creditable to the medical officer in charge and his assistant. An observatory always fares better when the medical officer in charge is interested in the work and encourages his assistant, as in this case.

Rajahmundry.—A new third class observatory was opened at this station on the 23rd of May 1884.

To prevent any delay in the erection, and to ensure uniformity in the design and dimensions, a thermometer shed, similar to those in use throughout the Madras Presidency, with posts and turnstile for the enclosure, was constructed and despatched to Rajahmundry. The head clerk of the Madras Meteorological Office was sent in charge of a barometer and complete set of thermometers, and directed to see the shed put up, to arrange the instruments, and to teach an assistant the duties required. With the kind aid of the Public Works Department, the shed was put up, and all arrangements completed by the 20th of May 1885. The medical officer in charge of the Civil Dispensary has kindly undertaken to superintend the meteorological observatory, and the barometer has accordingly been placed in an office room belonging to the Dispensary ; the height of its cistern above sea level being 112 feet. This instrument appears to have been roughly handled in transit from Calcutta, and was not in proper order on being unpacked. As soon as another can be produced it will be exchanged.

The thermometer shed is erected in the compound of the Civil Dispensary, and as far as I can judge from reports it is well situated. I hope soon to be able to visit the observatory at this station myself.

The posts and ropes round the shed were insufficient to prevent animals from intruding, and I have therefore supplied barb fencing, as at Cochin. The maximum thermometer was reported out of order some time ago, and has not yet been replaced. Pending the necessary structure for an anemometer, and the receipt of a fresh supply of wind vanes from Calcutta, these instruments have not been put up. The assistant's records appear to be taken with care.

Salem.—This station has fully maintained its good reputation throughout the year. When I inspected the observatory on the 26th March, I found everything in perfect order, and highly creditable to the medical officer in charge and his assistant. The only request I had to make was that a few tall casuarina trees not far from the anemometer might be topped, so that they should not interfere with the accuracy of the records of the wind velocity.

The assistant has reduced his observations carefully, and both records and reductions have invariably reached the Madras Meteorological Office in good time.

Secunderabad.—As stated in my last report, the shed at this observatory required painting and thoroughly repairing. This was accordingly done, and on inspecting the observatory on the 19th and 21st of August, I found everything highly satisfactory. The fencing had been extended right round the shed, and all the instruments were clean and in perfect order except the rain gauge, which required a new glass measure. I checked the 4 P.M. readings taken by the assistant, as I frequently do on these occasions, and found them very accurate. His work throughout the year has been all that could be desired.

Trichinopoly.—The thermometer shed had been painted and thoroughly renovated when I inspected the observatory on the 13th of March 1885.

A new turnstile, twenty posts and four rows of good iron wire had been put round the shed to prevent cattle from intruding. The old thermometer board was removed, and a teakwood cage

placed in its stead containing a set of new instruments, with the exception of a sun maximum thermometer which was not required. The dry and wet bulb hygrometer hitherto in use required re-comparing; all the other instruments were in good order, but the alteration of the arrangement rendered a complete change necessary. The anemometer platform and ladder are too weak to be safe; but as it is under consideration to change the place of this instrument, all extensive repairs have been deferred, and only the immediate wants attended to.

The mercury in the cistern of the barometer was slightly oxidized, but in other respects the instrument was in perfect order.

Trichinopoly being a second class station, ordinary observations have been recorded three times a day, *viz.*, at 10h., 16h. and 22h.; hourly observations on four days in each month, and the synoptic observations taken at the local time corresponding to 7 A.M. Washington mean time for the "United States International Weather Bulletin."

The register has been continuous, and the assistants have worked in a highly praiseworthy manner throughout the year. The records and reductions have reached the Madras office in better time, and everything has been satisfactory.

Wellington.—The work at this observatory has been quite satisfactory, and consequently calls for no special remarks.

The records and reductions have been carefully and accurately made and forwarded to my office with great regularity. No changes have been made in the instruments.

There has been a general improvement in the work of the Madras Presidency Meteorological Department during the official year 1884-85, and many thanks are due to the medical officers who have been in charge of the observatories for their able supervision and the general interest they have taken in the meteorology.

With the exception of the Post Master at Kurnool, who was inexperienced in reading instruments, and unable to attend this office for instruction, and the Telegraph Master at Mercara, who was transferred to another station, there have been no changes in the assistants. They have paid more attention to everything connected with their work, and the registers have been more accurately reduced and forwarded to me in better time.

Frequent inspection tends to arouse the interests of the assistants, and the observatories visited of late have been in more efficient order. There are often small defects, either in the instruments or the system of working, which are not noticeable to those in charge, but which immediately attract the attention of an Inspecting Officer. I also observe a marked difference in the condition of the observatories at which the medical officers in charge pay a little attention to the meteorology.

In checking the readings of each up-country assistant, I not only see whether they are accurate, but also their system of recording, whether they are quick or slow, &c. Owing to the insufficient accommodation for storing instruments when the Madras Astronomical Observatory and the Meteorological Office were in the same building, I have not hitherto had a sufficient supply of instruments to enable me to re-place, as speedily as I wished, any that were reported broken or defective.

The substitution of cages for thermometers in the place of the boards previously used will no doubt save the instruments; but even to the cages it has been found advisable to have locks and keys. Monkeys, jackals, and other animals frequently break the grass radiation thermometers, and in one or two cases their use on that account has been discontinued until some better arrangement can be made for their protection. At one or two of the Civil Dispensaries where the barometer is placed in a public room and the thermometer shed in a good open position, the instruments have been interfered with by mischievous individuals, and the medical officers have applied to me for watchmen. The supply of a particular kind of fencing will, I hope, prevent future difficulties of this kind. Most of the thermometer sheds have been repaired this year.

On the transfer of the Mercara observatory I am given to understand that a thorough renovation of the shed will be necessary. New anemometer stagings are urgently required at Cochin, Coimbatore, Cuddapah, Kurnool, Trichinopoly, and Rajahmundry, and as these are expensive items, their construction has been deferred until sanction can be obtained for the extra expenditure.

The work of the Madras Meteorological Office consisting chiefly of the revision of the records and registers received from observatories at which the assistants reduce their own observations; the reduction of the records of all the third class observatories; making extra copies for transmission to the Meteorological Reporter to the Government of India; preparing returns requested by other

Government Officials and the ordinary office daily routine, has been carried on by the same staff. Special attention was given to clearing up all arrears, and had it not been for sending two assistants away to up-country stations, it would have progressed more favourably.

The Revenue Board Rain Stations have not been handed over to me yet, but I believe it is in contemplation to do so at an early date.

* * * * * * * * * *

ELIZABETH ISIS POGSON, F.R. MET. SOC.,
Meteorological Reporter to the Government of Madras.

METEOROLOGICAL OFFICE, MADRAS,
27th July, 1885.

APPENDIX G

List of Officers in charge, and Assistants, in the Madras Presidency Meteorological Department in the official year 1884-85.

Station.	Officer in Charge.	From	To	Assistant.	From	To
Madras	Miss E. Isis Pogson, F.R. MET. SOC., Meteorological Reporter and Assistant Government Astronomer.	25th July 1881	31st Mar. 1885	J. Vythenathe Iyer, 1st	1st Feb. 1878	31st Mar. 1885.
				N. E. Kangayam Pillay, 2nd	1st Mar. 1882	31st Mar. ,,
				G. Narayanasawmy Naidu, 3rd	18th Aug. 1883	31st Mar. ,,
				David John, 4th	1st Feb. 1884	31st Mar. ,,
Amini Divi	Syed Laul	6th Feb. 1884	31st Mar. ,,			
Bangalore	Surgeon-Major J. North	20th Feb. ,,	20th May 1884	Rungasawmy Moodeliar	1st Sep. 1871	31st Mar. ,,
	,, A. F. Dobson, M.B.	21st May ,,	31st Mar. 1885			
Bellary	,, H. M. G. Archdall	11th Feb. 1881	31st Mar. ,,	B. G. Sashachellum Naidu, 1st	31st Aug. 1878	31st Mar. ,,
				Sreenavasa Row, 2nd	21st Dec. 1881	31st Mar. ,,
Cochin	Brigade-Surgeon W. H. Morgan	24th May 1882	8th May 1884	M. V. Eippe	18th Aug. 1883	31st Mar. ,,
	Surgeon K. C. Sanjana	9th May 1884	5th Sep. ,,			
	Brigade-Surgeon W. H. Morgan	6th Sep. ,,	31st Mar. 1885			
Coimbatore	Surgeon-Major J. F. Fitzpatrick, M.D.	2nd May 1882	9th Mar. ,,	Varadiah Naidu	1st July 1877	31st Mar. ,,
	Surgeon S. C. Sarkies	10th Mar. 1885	31st Mar. ,,			
Cuddapah	,, G. Iyasawmy	15th Mar. 1884	8th June 1884	V. A. Vijaravalu Moodeliar	15th Mar. 1884	31st Mar. ,,
	,, M. J. Kelawala	9th June ,,	28th June ,,			
	,, G. Iyasawmy	29th June ,,	31st Mar. 1885			
Kurnool	Post Master V. Venkataseshayya	20th Oct. 1883	20th Sep. 1884			
	G. R. Paramaswara Iyer	21st Sep. 1884	31st Mar. 1885			
Madura	Surgeon-Major W. J. Hastings, M.D.	16th Oct. 1883	12th May 1884	V. Sashachellum Naidu	19th Nov. 1867	31st Mar. ,,
	Surgeon J. Kernan	13th May 1884	31st July ,,			
	Surgeon-Major W. J. Hastings, M.D.	1st Aug. ,,	16th Oct. ,,			
	Surgeon G. M. E. McKee	17th Oct. 1883	21st Nov. ,,			
Madura	,, F. C. Smith	22nd Nov. 1884	31st Mar. 1885			

List of Officers in charge, and Assistants, in the Madras Presidency Meteorological Department in the official year 1884-85—contd.

Station.	Officer in charge.	From	To	Assistant.	From	To
Mangalore	Telegraph Master R. S. D'Souza	10th Feb. 1884	17th April 1884			
	„ E. D'Souza	18th April „	31st Mar. 1885			
Masulipatam	Surgeon-Major J. H. Ritchie	9th Nov. 1883	17th April 1884	Uma Ranganayakulu Naidu	19th Nov. 1867	31st Mar. 1885
	Surgeon F. J. Doyle	18th April 1884	25th Dec. „			
	Surgeon-Major J. B. Thomas, L.R.C.P.L.	26th Dec. „	31st Mar. 1885			
Mercara	Telegraph Master H. Duckworth	29th Mar. 1880	3rd April 1884			
	Depy. Tel. Master T. S. Arunachallum	4th April 1884	18th April „			
	Telegraph Master H. Duckworth	19th April „	15th Oct. „			
	Depy. Tel. Master T. S. Arunachallum	16th Oct. „	31st Mar. 1885			
Negapatam	Surgeon E. A. Morris, L.R.C.P.L.	15th Nov. 1880	11th Nov. 1884	S. Saminatha Iyer	5th Sep. 1874	31st Mar. „
	Surgeon H. St. C. Carruthers	12th Nov. 1884	31st Mar. 1885			
Rajahmundry	Surgeon E. Levinge	15th May „	31st Mar. „	A. Mukanda Row Naidu	15th May 1884	31st Mar. „
Salem	Surgeon-Major A. L. Hackett	29th Dec. 1883	18th April 1884	L. Ramsing	13th Oct. 1880	31st Mar. „
	Surgeon-Major J. L. Ratton	19th April 1884	20th Feb. 1885			
	Surgeon J. Kernan	21st Feb. 1885	31st Mar. „			
Secunderabad	Surgeon-Major T. C. H. Spencer	15th Dec. 1882	22nd Mar. „	J. T. Williams	27th Feb. 1882	31st Mar. „
	Surgeon G. F. Bevan	23rd Mar. 1885	31st Mar. „			
Trichinopoly	Surgeon-Major L. C. Nanney, M.D.	27th July 1883	13th April 1884	T. Lutchman Row, 1st	21st Nov. 1874	31st Mar. „
	Surgeon A. M. Rogers-Harrison	14th April 1884	30th June „	E. M. Bhojarajooloo Naidu, 2nd	1st Dec. 1881	31st Mar. „
	Surgeon-Major L. C. Nanney, M.D.	1st July „	31st Mar. 1885			
Wellington	Surgeon-Major C. F. Churchill, M.D.	17th Nov. 1883	19th Jan. „	H. Brownsell	1st Aug. 1880	31st Mar. „
	Surgeon-Major W. G. Grant	20th Jan. 1885	31st Mar. „			

APPENDIX H.

Administration Report on the Meteorological Observatories by the Sanitary Commissioner, British Burma, for the year 1884-85.

Since the submission of previous report, all the observatories in the province have been inspected by me.

The leaf roof of the thermometer shed at Rangoon was too thin, and admitted direct rays of heat and light somewhat freely. The aneroid [anemograph?] had been removed for repairs, but has since been replaced. The other instruments were *in situ*, and appeared in good working order.

At Bassein, Moulmein, and Mergui the meteorological instruments and records were found, the former in order, and the latter correct and up to date. The several superintendents spoke favourably of their observers.

The attention of the Executive Engineer was invited to the state of the wind vane at Thyetmyo which did not work easily or smoothly. Otherwise the instruments and records connected with this observatory were found in a satisfactory condition.

At Toungoo during my visit the stand for the wind gauge and vane was under construction. The new thermometer stand had been completed, and occupies a fairly good position near the dispensary; the removal of several trees in the vicinity was recommended. Records carefully kept by Hospital Assistant Shaik Hydiat Ally who was highly commended by the superintendent.

The accompanying lists show:—

(*a*) The superintendents and observers for the year.

(*b*) The instruments issued to each observatory.[1]

D. SINCLAIR, M.B.,
Sanitary Commissioner, British Burma.

[1] Incorporated in Appendix K.

APPENDIX H I.

Return showing the names of Superintendents and Observers of the Meteorological Observatories in British Burma for the year 1884-85.

Station.	Class.	Superintendents.	Period. From	Period. To	Observers.	Period. From	Period. To
Rangoon	Second	Surgeon-Major H. Johnstone, M.D.	1st April 1884	31st Mar. 1885	G. E. Wales, Observer	1st April 1884	31st Mar. 1885.
					O. White, Assistant Observer	1st April ,,	31st Mar. ,,
Bassein	Ditto	Surgeon S. H. Dantra	1st April ,,	3rd Dec. 1884	Moung Hpay	1st April ,,	31st Mar. ,,
		Chand Khan, Hospital Assistant	4th Dec. ,,	5th Dec. ,,			
		Surgeon P. W. Dalzell	6th Dec. ,,	3rd Mar. 1885			
		Surgeon S. H. Dantra	4th Mar. 1885	31st Mar. ,,			
Thyetmyo	Third	Surgeon C. W. E. Foster	1st April 1884	25th May 1884	Alla Deen, Hospital Assistant	1st April ,,	31st Mar. ,,
		Surgeon E. P. Frenchman	26th May ,,	14th Mar. 1885			
		Surgeon P. W. Dalzell	15th Mar. 1885	31st Mar. ,,			
Moulmein	Ditto	Brigade-Surgeon W. F. de Fabeck, M.D.	1st April 1884	31st Mar. ,,	F. St. Hilbert Hospital Assistant	1st April ,,	31st Mar. ,,
Mergui	Ditto	Mr. P. G. Paul	1st April ,,	31st Mar. ,,	Moosajee	1st April ,,	31st Mar. ,,
Toungoo	Ditto	Surgeon P. W. Dalzell	1st April ,,	19th Nov. 1884	M. Baboo, Hospital Assistant	1st April ,,	30th April 1884.
		Surgeon M. Smith	20th Nov. ,,	31st Mar. 1885	Shaik Hydiat Ally, Hospital Assistant	1st May ,,	31st Mar. 1885.

D. SINCLAIR, M.B.,
Sanitary Commissioner, British Burma.

APPENDIX I.

Return of the Stock Receipt and Issue of Instruments for the year 1884-85.

Instruments.	In Store on 1st April 1884.	Received 1884-85.	Issued 1884-85.
Van Rysselberghe's meteorograph	1	...	...
Barometers, observatory, Fortin's principle	10	10	12
Do. do. Kew principle	8	6	8
Do. mountain, portable tripod (Adie)	10	11	1
Do. marine, Kew principle	6	17	3
Do. Newman's large standard	2	...	...
Do. do. small standard	2	1	...
Do. Negretti and Zambra (various)	5	2	...
Aneroids	19	3	4
Thermometers standard with attached scales	47	2	3
Do. without attached scale (chemical)	1	...	...
Do. for hygrometers (Kew pattern)	69	6	39
Sling thermometers	10	...	3
Thermometers, maximum, for shade	87	20	39
Sun thermometers not in vacuo	2	...	...
Thermometers, minimum, for shade	47	19	33
Do. do. radiation	22	23	31
Six's thermometers	6	...	...
Thermometers solar in vacuo (self-registering)	35	5	31
Do. do. (non-self-registering)	21	...	...
Frankland's sun thermometers	5	...	2
Ponillet's pyrheliometer	1	...	...
Stewart's actinometers (thermometers for)	...	15	6
Do. do. (chamber for)	...	1	...
Hodgkinson's actinometers	2	...	...
Herschell's do.	1	...	...
Regnault's hygrometers	3	...	...
Daniell's do.	10	...	...
Halleur's do.	5	...	...
Boiling point thermometers	7	...	...
Pocket spectroscopes (Browning's)	2	...	...
Wind vanes	7	1	8
Anemometers	28	18	28

Return of the Stock Receipt and Issue of Instruments for the year 1884-85—contd.

Instruments.	In Store on 1st April 1884.	Received 1884-85.	Issued 1884-85.
Beckley's anemographs	2	1	3
Rain-gauges (Symons' and Glaisher's)	12	52	15
Measure glasses for do.	35	...	25
Reading lenses	1	2	1
Sun thermometer stands	14	...	10
Radiation pads	...	8	6
Thermometer cages	3	12	12
Do. do for ships	15	...	1
Prismatic compass	1	...	...
Magnetic do.	...	1	1
Sand glasses (3 minutes)	46	...	3
Sunshine recorders	1	2	...
Bull's eye lanterns	1	...	1
Salinometers	36	...	1
Common thermometers, brass scales	27	...	...
Clocks	2	9	11
Watch	1	...	1
Spirit level	1	...	...
Hicks barograph	1	...	...
Thermograph with Negretti and Zambra's sets of recording thermometers	1	...	...
Electrophorus	1	...	...
Nephescope	...	1	1
Electrical anemometer and wind vanes	...	3	...
Filled tubes for marine Kew principle barometer	...	12	...
Do. observatory do. do.	13	...	5

APPENDIX K.

Return of the Instruments issued to each Observatory in 1884-85.

Province.	Station.	Barometer.	Hygrometer. Dry bulb.	Hygrometer. Wet bulb.	Hygrometer. Dry Maximum thermometer.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer	Wind Vane.	Rain-gauge.	Measure-glass.	Lenses.	Clock **	Sand-glass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Cages.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometers.	Bull's eye lantern.	Actinometer thermometer.	Nephescope.	Bottle for wet bulb thermometer.	Frankland sun thermometer.	Remarks.
Afrika.	Zanzibar	...	...	...	...	...	...	...	2*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	* In lieu of one broken.
Arabia.	Aden	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Persia.	Bushire	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Beluchistan.	Quetta	...	...	...	...	*	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Cashmere.	Leh	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Cashmere.	Chamba	1	...	...	...	..	...	...	...	...	...	...	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	
Darjeeling.	Pedong	1	1	1	1	1	1	...	...	...	...	1	1	...	..	...	...	1	...	...	1	...	...	...	...	...	...	...	Original furniture.
Punjab.	Lahore	...	2	2	2	2	2	3†	2	1	1	1	1	2	...	1	..	2	1	1	1	...	1	...	...	...	...	...	...	† One non-self-registering
Punjab.	Peshawar	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Punjab.	Rawalpindi	...	...	...	...	...	..	...	1	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Punjab.	Murree	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Punjab.	Sialkot	...	...	...	...	...	...	...	2	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
Punjab.	Ludhiana	...	...	...	...	...	2	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
Punjab.	Sirsa	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
Punjab.	Delhi	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Punjab.	Simla	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	
N.-W. Provinces and Oudh.	Allahabad Old	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	1	
N.-W. Provinces and Oudh.	Allahabad New	...	...	...	1	...	...	1	1‡	...	...	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	...	...	‡ To be used as surface thermometer.
N.-W. Provinces and Oudh.	Agra	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
N.-W. Provinces and Oudh.	Lucknow	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
N.-W. Provinces and Oudh.	Ranikhet	...	...	...	...	...	...	...	..	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
N.-W. Provinces and Oudh.	Bareilly	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
N.-W. Provinces and Oudh.	Benares	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
N.-W. Provinces and Oudh.	Meerut	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
N.-W. Provinces and Oudh.	Dehra	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	...	...	...	
Assam.	Sibsagar	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Assam.	Dhubri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	
Assam.	Tezpore	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Alipore	...	1	1	1	...	...	1	...	...	...	2	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	1	
Bengal.	Patna	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Hazaribagh	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	
Bengal.	Saugor Island	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Cuttack	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Chittagong	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Darjeeling	...	...	...	...	...	...	1	1	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	
Bengal.	Berhampore	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Burdwan	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Jessore	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	False Point	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Midnapore	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Noakhally	1	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Burrisal	1§	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	§ K. P. observatory bars sent to replace marine barometers.
Bengal.	Serajgunj	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bengal.	Comilla	1§	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	

Return of the Instruments issued to each Observatory in 1884-85—continued.

Province.	Station.	Barometer.	Hygrometer. Dry bulb.	Hygrometer. Wet bulb.	Minimum thermometer. Dry maximum thermometer.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometers. Solar.	Radiation thermometers. Grass.	Anemometer.	Wind Vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sand-glass.	Stand for rain thermometer.	Pad for grass radiation thermometer.	Cages.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometer.	Bull's eye lantern	Actinometer thermometer.	Nephroscope	Bottle for wet bulb thermometers	Compass.	Remarks.
Bengal—*contd.*	Furreedpore	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	* K. P. observator barometers sent to replace marine barometers.
	Rampore Beauleah	1*	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Dinagepore	2†	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	† Readings being unsatisfactory, barometer exchanged.
	Rungpore	2	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Julpaigoree	1*	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Bhagalpore	1*	...	...	...	...	...	...	...	1	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Buxar	...	...	...	...	...	...	...	...	22	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	‡ Readings unsatisfactory, anemometer recalled.
	Arrah	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Nya Doomka	1*	...	...	...	...	...	...	...	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	
	Chyebasa	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	§ Broken in transit.
	Bogra	2§	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	Original furniture.
	Chowringhee (Calcutta)	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Central Provinces.	Nagpur	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Jubbulpore	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	
	Pachmarhi	...	...	...	1	...	1	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Saugor	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Seoni	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Raipur	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Sambalpur	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	
	Chanda	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Berar.	Chikalda	...	...	...	...	...	...	...	...	1‖	...	...	...	...	1‖	...	...	...	...	...	...	...	...	...	...	...	...	...	‖ In lieu of one out of order.
	Buldana	...	...	...	...	...	...	...	...	...	...	...	...	...	1‖	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Amraoti	...	...	...	...	...	...	...	...	1¶	...	...	...	...	1‖	1	...	...	...	...	...	...	...	...	...	...	...	...	
Central India.	Indore	...	...	...	...	...	...	...	1†	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Nowgong	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Sutna	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Rajputana.	Bickaneer	...	...	...	...	...	...	1¶	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	¶ In lieu of one stolen.
	Pachpadra	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Jeypore	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bombay.	Bombay	...	...	...	...	...	...	1**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	** In lieu of one withdrawn for re-examination.
	Poona	...	...	...	...	...	...	...	1††	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	†† In lieu of one broken.
	Deesa	1‖	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Jacobabad	...	...	...	...	...	...	1††	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Hyderabad	...	...	...	...	...	...	...	1††	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Bhuj	...	...	...	...	...	...	...	...	1‖	...	...	...	...	...	1††	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Malegaon	1**	...	...	...	...	...	...	1††	1**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Sholapur	...	...	...	...	...	...	...	1††	1**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Mount Abu	...	...	...	...	...	...	...	2††	...	...	...	1††	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1¶	
	Karwar	...	...	...	...	...	...	...	1††	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	

Return of the Instruments issued to each Observatory in 1884-85—concluded.

Province.	Station.	Barometer.	Hygrometer. Dry bulb.	Hygrometer. Wet bulb.	Dry maximum thermometer.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer.	Wind vane.	Rain-gauge.	Measure-glass.	Lenses.	Clock.	Sand glass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Cage.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometer.	Bull's eye lantern.	Actinometer thermometer.	Nephescope.	Bottle for wet bulb thermometer.	Salinometer.	Remarks.
Madras, Mysore, and Coorg.	Gopalpur	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	
	Trichinopoly	...	1	1	1	1	1	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Cochin	...	1	1	1	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Masulipatam	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Madura	...	1	2	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Salem	...	..	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Wellington	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	
	Negapatam	1	1	2	1	1	1	...	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	
	Bangalore	...	1	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Kurnool	...	...	...	1	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	
	Cuddapah	1	1	...	...	...	...	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Rajamundry	1	1	1	1	1	1	1	1	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Mercara	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	
British, Burma.	Rangoon	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Tounghoo	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Akyab	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	
Bay Island.	Nancowry	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	S. S. *Calcutta*	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	Original furniture.
	F. L. V. *Foam*	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Ajmere (Forest Dept.)	...	2	3	3	2	2	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	
	Afghan Boundary Commission	...	...	...	3	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	3	...	...	...	...	...	
	Simla Office	...	...	...	...	...	...	...	...	...	...	2	2	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Cinchona plantation, Madras	...	1	1	1	2	1	1	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Simla (Deputy Commissioner)	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Meteorological Office, Bengal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	
	Mathematical Instrument Dept.	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Mr. W. L. Dallas	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	

APPENDIX L.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	The Editor of the *Delhi Gazette*.
Ajmere	Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Director of the Meteorological Service of the École des Sciences d'Alger.
Allahabad	Secretary to the Government, North-Western Provinces and Oudh.
	Department of Revenue and Agriculture, North-Western Provinces and Oudh.
	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
	Editor of the *Pioneer*.
Amsterdam	Royal Academy of Sciences.
Bangalore	Chief Commissioner, Mysore and Coorg.
	Conservator of Forests, Mysore and Coorg.
Batavia, Java	Meteorological Observatory.
Berlin	Ditto Institute.
Bombay	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
	Bombay University.
	Asiatic Society of Bombay.
	Sassoon Mechanic's Institute.
	Geographical Society of Bombay.
	Editor of the *Bombay Gazette*.
	Ditto *Times of India*.
	Elphinstone College.
Brisbane, Queensland	Observatory.
Brussels	Royal Academy of Sciences.
	Observatoire Royal.
Bucharest, Roumania	Meteorological Institute.
Budapesth	Observatory.
Calcutta	Secretary of State for India (through Revenue and Agricultural Department).
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto Home Department.
	Ditto ditto Public Works Department.
	Ditto ditto Foreign Department.
	Ditto ditto Department of Finance and Commerce.
	Ditto ditto Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor General of India.
	Superintendent, Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanical Gardens, Calcutta.
	Inspector-General of Forests, with the Government of India.
	Surgeon-General ditto ditto.
	Asiatic Society of Bengal.
	Indian Museum Library.
	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the *Calcutta Review*.
	Ditto *Statesman and Friend of India*.

List of Recipients of the Publications of the Meteorological Office—continued.

Calcutta—*contd.*	Editor of the *Englishman.*
	Ditto *Indian Daily News.*
	Ditto *Hindu Patriot.*
	Ditto *Indian Agriculturist.*
	St. Xavier's College Observatory.
	The Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
Cambridge	University Library (through H.M.'s Secretary of State for India).
Cambridge, Massachusetts	Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Chemnitz	Royal Meteorological Institute.
Chatham	Royal Engineers' Library (through Revenue and Agricultural Department).
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
Colombo	Editor of the *Ceylon Times.*
	Ditto *Ceylon Observer.*
	Surveyor General of Ceylon.
Constantinople	Observatoire Impérial Météorologique.
Copenhagen	Danske Meteorologiske Institut.
	Royal Danish Academy of Sciences.
Cordoba	Meteorological Office.
	National Academy of Science.
Darjeeling	Conservator of Forests, Government of Bengal.
Dehra Dun	Editor of the *Indian Forester.*
	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Dublin	Royal Dublin Society.
Dacca	Dacca College.
Edinburgh	Scottish Meteorological Society.
	Astronomer Royal for Scotland, Royal Observatory.
Ellichpore	Assistant Conservator of Forests, Melghat Division.
Goa	Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Guatemala	Observatorio Meteorologico del Institut Nacional de Guatemala.
Hamburgh	Nord Deutsche Seewarte.
	Deutsche Meteorologische Gessellschaft.
Havana	Real Colegio de Belen.
Hong-Kong	Observatory.
Indore	Agent to the Governor General for Central India in charge of the Residency.
Iowa, U. S.	Iowa Weather Service.
Jeypore	Maharajah's Observatory.
Jubbulpore	Civil Surgeon of Jubbulpore.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests, Bombay, Sind Division.
Lahore	Secretary to the Government of the Punjab.
	Meteorological Reporter ditto ditto.
	Sanitary Commissioner ditto ditto.
	Conservator of Forests ditto ditto.
	Editor of the *Indian Public Opinion.*
Leeds	Yorkshire College (through H. M.'s Secretary of State for India).
Lisbon	Observatoire de Infante d'Luiz.
	Academy of Sciences.
London	Meteorological Council.
	Royal Society.
	Royal Asiatic Society (through H.M.'s Secretary of State for India).
	Northbrook Indian Club (through H. M.'s Secretary of State for India).

List of Recipients of the Publications of the Meteorological Office—continued.

London—*contd.*	Society of Arts.
	Institution of Civil Engineers.
	Royal School of Mines.
	Royal Meteorological Society.
	Admiralty Library.
	United Service Museum.
	British Museum (through H. M.'s Secretary of State for India).
	Athenæum Club.
	Editor of the *Philosophical Magazine.*
	Ditto *Athenæum.*
	Ditto *Nature.*
	Ditto *Symon's Monthly Meteorological Magazine.*
	Ditto *Westminster Review.*
	Ditto *Quarterly Review.*
Madras	Secretary to the Government of Madras.
	Ditto ditto Public Works Department.
	Meteorological Reporter to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, Government of Madras.
	Madras University.
	Editor of the *Madras Times.*
	Ditto *Madras Athenæum.*
	Ditto *Madras Mail.*
	Superintendent, Government Central Museum.
	Agricultural Reporter, Government of Madras, Saidapet.
	Surgeon General, British Medical Department.
	Ditto Indian Medical Department.
	Master Attendant of Madras.
	Conservator of Forests, Northern Circle.
Madrid	Royal Observatory.
Magdeburgh	Observatory of the Magdeburgh Zeitung.
Manchester	Literary and Philosophical Society.
Manila	Meteorological Observatory.
Mauritius	Meteorological Society.
Melbourne, Victoria	Observatory.
	University Library.
	Public Library.
Mexico	Central Meteorological Observatory.
Milan	Royal Astronomical Observatory.
Munich	Royal Observatory.
	Royal Bavarian Academy of Sciences.
	Geographical Society.
Nagpur	Chief Commissioner, Central Provinces.
	Sanitary Commissioner ditto.
	Inspector General of Education, Central Provinces.
	Superintendent, Meteorological Observatory.
	Conservator of Forests, Central Provinces.
Nainital	Ditto ditto North-Western Provinces and Oudh.
New Haven, Connecticut	Connecticut Academy of Arts and Sciences.
	Editors of the *American Journal of Science.*
New York, U. S.	Central Park Observatory.
Nowgong-Rajshahye	Sub-Divisional Officer.
Ootacamund	Conservator of Forests, Government of Madras.
	Editor of the *South of India Observer.*
Oxford	Radcliffe Library.
	Radcliffe Observatory.
Paris	Observatoire Physique Central de Montsouris.
	Editor of *La Nature.*
	Physical Observatory, Meudon.
	Bureau Central Météorologique.
	Meteorological Society of France.

List of Recipients of the Publications of the Meteorological Office—concluded.

Perpignan, France	Commission Méterol. des Pyrénées Orientales.
Perth, W. Australia	Surveyor General.
Pesaro, Italy	Royal Observatory.
Philadelphia	Franklin Institute.
Poona	Conservator of Forests, Bombay, Northern Division.
Prag, Bohemia	Observatory.
Raipur	Civil Surgeon of Raipur.
Rangoon	Chief Commissioner, British Burma. Sanitary Commissioner, ditto. Conservator of Forests, ditto. Editor of the *Rangoon Times*.
Rome	Meteorological Office (Ministry of Agriculture).
Rio de Janeiro	Imperial Observatory.
Shaharunpore	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Chief Commissioner of Assam. Conservator of Forests, Assam.
Simla	Assistant Quarter-Master General, *Intelligence Branch*.
Singapore	Principal Civil Medical Officer, *Straits Settlements*.
Stockholm	Nautisk Meteorologiska Byran.
St. Petersburg	Observatoire Physique Central. Geographical Society of Russia.
Strasburg	Imperial University Library.
Stonyhurst	Stonyhurst College Observatory.
Sydney	Observatory. University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokei, Japan	Imperial Mining Office. Imperial Meteorological Observatory.
Toronto, Canada	Magnetical and Meteorological Observatory.
Turin	Royal Astronomical Observatory.
Upsala	Meteorological Observatory.
Utrecht	Royal Dutch Meteorological Institute.
Vienna	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus. K. K. Geologische Reichsanstalt. Imperial Academy of Sciences. Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
Washington, U. S.	Chief Signal Officer, United States Army. Smithsonian Institution. Naval Observatory. Hydrographic Office. Professor Cleveland Abbe, Signal Office. United States' Geological Survey.
Wellington, New Zealand	Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Institute.

APPENDIX M.

Presentations to the Library from the 1st April 1884 to the 31st March 1885.

Place.	Donors.	Title of Work.
ADELAIDE	Meteorological Observatory	Meteorological observations made at the Adelaide Observatory and other places in South Australia, and the Northern Territory during the year 1881.
ALGIERS	Meteorological Service	Bulletin Météorologique du Gouvernment général de l'Algérie; 26th March and 27th October 1883; 10th January 1884 to 15th February 1885, (wanting 1—15th November 1884.)
ALLAHABAD	Meteorological Office	Sketch of the Meteorology of the year 1883 in the North-Western Provinces and Oudh and Eastern Rajputana.
AMSTERDAM	Royal Academy of Sciences	Processen-Verbaal, 1882-83.
		Jaarboek, 1882.
		Verslagen en Mededeelingen Afd Natuurkunde: Tweede Reeks, Volume XVIII.
BATAVIA	Magnetical and Meteorological Observatory.	Rainfall in the East Indian Archipelago, 5th year, 1883.
BERLIN	Dr. G. Hellmann	Grösste Niederschlagsmengen in Deutschland.
	Prussian Statistical Bureau	Preussische Statistik LXXVIII, Ergebnisse der meteorogischen Beobachtungen im Jahre, 1882.
BOMBAY	Government of Bombay	Bombay magnetical and meteorological observations, 1879 to 1882, with five appendices.
		Twelfth Annual Report of the Sanitary Commissioner for the Government of Bombay for 1883, with appendices.
		Bombay Gazetteer, Vols. VIII, XXI, XXII & XXIII.
BRISBANE	Robert L. Jack, Esquire	Report on the Tin Mines of Herberton, Western and Thomson's Creek Districts, and the Silver Mines of the Dry River, Queensland.
BRUSSELS	Observatoire Royal de Bruxelles	Diagrammes du Météorographe van Rysselberghe. Observatoire Royal de Bruxelles, 1879, 1880, 1881, 1882.
		Vade-Mecum de l'Astronome.
		Observations météorologiques faites aux stations internationales de la Belgique et des Pays Bas, Quatrième Année, 1880.
		Annuaire de l'observatoire Royal de Bruxelles, 1882, 1883, 1884.
		Exposition critique de la méthode de Wronski pour la resolution des problèmes de mécanique celeste. Premiere-Partie.
BUCHAREST (Roumania)	Meteorological Service	Review of the meteorological services in Europe.
CALCUTTA	Comptroller-General	Civil Estimates, 1884-85.
	Geological Survey of India	Records, Vol. XVII, parts 2 and 4; Vol. XVIII, part 1.
		Memoirs, Vol. XXI, parts 1 and 2.
	Government of Bengal	Returns of the rail-borne traffic of Bengal during the quarters ending 31st December 1883, 31st March, 30th June, and 30th September 1884.
		Report on the Internal Trade of Bengal for the year 1883-84.
		Report on the External Trade of Bengal with Nepal, Sikkim and Bhutan for the year 1883-84.
	Government of India, Home Department.	Report of the Meteorological Council of the Royal Society for the year ending 31st of March 1883.
		Progress Report of the Forest Administration in Ajmere-Merwara for 1883-84.
	Government of India, Revenue and Agricultural Department.	Journal of Indian Art, No. 2.
		Report of the census of British India taken on the 17th February 1881, Vols. I and III.
		Meteorological observations made at the Hon'ble East India Company's Magnetical Observatory at Singapore in 1841 to 1845.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—continued.

Place.	Donors.	Title of Work.
CALCUTTA—*contd.*	Government of India, Revenue and Agricultural Department.	Report on the condition and proceedings of the Government Observatory, Colaba, for the year ending 30th June 1884.
		Note on the Census of British India in 1881.
		Return of the storms which have visited the British Islands between 1st January 1874 and 31st December 1883, and of which no warning has been issued from the Meteorological Office, London, with a notice of the quarter from which each unwarned storm has reached the coast.
		Administration Report upon the Madras Observatory for 1883.
		Report of the Indian Famine Commission, Appendix, Vol. III, Chap. I.
		Civil Travelling Allowance Code, Second Edition.
		Report on the Mysore Census of 1881.
	Henry F. Blanford	Remarks on the autographic trace of the Calcutta barograph from the 26th to 30th August 1883.
		The Theory of the Winter Rains of Northern India.
	Meteorological Office, Bengal	Report on the Administration of Bengal, 1883-84.
	Sanitary Commissioner with the Government of India.	Tenth Annual Report of the Sanitary Commissioner with the Government of India for 1873.
		Twentieth Annual Report of the Sanitary Commissioner with the Government of India for 1883.
		Cholera: What can the State do to prevent it?
	St. Xavier's College Observatory	Meteorological observations taken at the St. Xavier's College Observatory, January to June 1884.
	Surveyor General of India	General Report on the Operations of the Survey of India Department during 1882-83.
CAPE OF GOOD HOPE	Meteorological Commission	Report of the Meteorological Commission for the year 1883.
CARLSRUHE	Bureau für Meteorologie und Hydrographie.	Jahres-Bericht des Centralbureaus für Meteorologie und Hydrographie im Grossherzogthum Baden nebst den Ergebnissen der meteorologischen Beobachtungen und der Wasserstandsaufzeichnungen am Rhein und an seinen grössern Nebenflüssen für das Jahr, 1883.
CHEMNITZ	Royal Meteorological Institute	Jahrbuch, 1883.
		Decaden Berichte, 1883.
		Wetterbericht, 1883, July 22nd to December 31st.
CHRISTIANA	Norske Meteorologiske Institut	Jahrbuch des Norwegischen Meteorologischen Instituts für 1883.
COLOMBO	Surveyor General of Ceylon	The Meteorology of Ceylon in 1882 and 1883, and average results from 1869.
COPENHAGEN	Institut Météorologique Danois	Bulletin météorologique du Nord. February 1884 to January 1885.
		Resumé des travaux de l'expédition polaire Danoise Internationale.
	Royal Danish Academy of Sciences	Oversigt No. 3 of 1883; No. 1 of 1884.
CORDOBA	National Academy of Science	Boletin de la Academia Nacional de Ciencias en Cordoba (Republica Argentina) Tomo VI, Tomo VII Entrega 1ª and 2ª.
		La variabilidad interdiurna de la temperatura en algunos puntos de la republica Argentina de America del sud en general, parts I and II.
		Ideas sobre una exploracion sistematica del clima de la provincia de Cordoba sin instruments.
		Actas de la Academia Nacional de Ciencias en Cordoba Tome V, Entrege primera.
		Observations météorologiques faites a Cordoba (Republique Argentine) pendant l'année 1883.
DEHRA DUN	The Editor	The Indian Forester, Vol. X, Nos. 4 to 12; Vol. XI, Nos. 1 to 3.
	Trigonometrical Branch, Survey of India.	Synopsis of the results of the operations of the Great Trigonometrical Survey of India, Vols. XVII to XXI.
DETROIT, MICH	The Publishers	The American Meteorological Journal, Vol. I, No. 1.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—continued.

Place.	Donors.	Title of Work.
DORPAT	Meteorological Observatory	Meteorologische Beobachtungen angestellt in Dorpat im Jahre 1877 and Jahren 1878, 1879, 1880.
EDINBURGH	Scottish Meteorological Society	Journal, 3rd series, No. 1.
GOA	Royal Observatory	Observacoes Meteorologicas de Goa 2nd semestere do Anno de 1881.
GREENWICH	Royal Observatory	Greenwich magnetical and meteorological observations for 1882.
HAMBURGH	Deutsche Meteorologische Gesellschaft.	Meteorologische Zeitschrift, January 1884 to January 1885.
	Deutsche Seewarte	Wetterbericht, Vol. IX, Nos. 61 to 336; Vol. X, Nos. 1 to 59.
		Monatliche Übersicht der Witterung; September to December 1883 and Jahre, January to June 1884.
		Archiv der Deutschen Seewarte Jahr. IV, 1881.
		Meteorologische Beobachtungen in Deutschland 1879 to 1880.
	Dr. A. Von Danckelman	Mémoire sur les observations Météorologiques faites a Vivi (Congo Inferieur) et sur la climatologie de la côte sudouest d'Afrique en Général.
	Dr. W. Köppen	Bericht über die Verwaltung der meteorologischen Abtheilung der Regierung von Indien im Jahre 1882-83.
HAVANNA	Real Collegio de Belen	Observaciones Magneticas y Meteorológicas, Anô 1875.
HONGKONG	Government Astronomer	Weather Report, January to July 1884.
		Report on the Organization of the Meteorological Service in China; and Instructions for making Meteorological Observations, prepared for use in China.
		Report on some Magnetical Observations made in October and November 1883.
		Report on the Mean Direction and Force of the Wind at Victoria Peak, Hongkong.
		Report on the Mean Cloudiness of Hongkong.
		Report on the Mean Monthly and Annual Rainfall at Hongkong.
		Notices about Storm Signals in the China Sea.
		Report of the Government Astronomer for 1884.
		Instructions for making Meteorological Observations, prepared for use in China.
JEYPORE	Superintendent of Raj Dispensaries	Annual Report of the Jeypore Medical Institutions for 1883.
KEW	G. M. Whipple	Preliminary enquiry into the causes of the variations in the readings of the black bulb thermometer in vacuo.
	Kew Committee of the Royal Society.	Report of the Kew Committee for the year ending 31st October 1884.
LAHORE	Meteorological Office	Annual Report on the Meteorology of the Punjab for the year 1883-84.
LONDON	G. J. Symons, Esq.	Symons's Monthly Meteorological Magazine, March 1884 to January 1885.
	Hon'ble Ralph Abercromby, F.R.M.S.	The Explanation of certain Weather Prognostics.
		The Reduction of Wind Records.
	Meteorological Office	Weekly Weather Report, title page for Volume IV (1883).
		" " " new series, Vol. I, Nos. 1 to 43.
		Daily Weather Reports, 1st July 1883 to 30th June 1884.
		The Monthly Weather Report, January to October 1884.
		A Barometer Manual for the use of Seamen.
		Report of the Meteorological Council to the Royal Society for the year ending 31st March 1883.
		Quarterly Weather Report, new series, parts III and IV, 1876; Appendices and Plates, 1878.
		Hourly Readings, 1882, parts II and III.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—continued.

Place.	Donors.	Title of Work.
LONDON—*contd.*	Meteorological Office	Charts showing the surface temperature of the Atlantic, Indian, and Pacific Oceans.
	R. H. Scott, F.R.S.	Note on a series of barometrical disturbances which passed over Europe between the 27th and the 31st of August 1883.
		Report from H. B. M.'s Consul at Batavia, enclosing extract relating to the volcanic outbursts in the Sunda Straits from the Logbook of S.S. "Governor General, London."
		The Equinoctial Gales: Do they occur in the British Isles.
	Royal Asiatic Society	Journal, Volume XVI.
	Royal Meteorological Society	Charter and Bye-laws of the Royal Meteorological Society.
		The Meteorological Record, Nos. 11 to 14.
		List of Fellows of the Royal Meteorological Society, 1st March 1884.
		Quarterly Journal, new series, Vol. X, Nos. 49 to 52.
	Royal Society	Proceedings, Vol. XXXV, No. 227; Vol. XXXVI, Nos. 228 to 231; Vol. XXXVII, No. 232.
	Society of Arts	Journal, Nos. 1634 to 1685.
		Index to Volumes XXI to XXX (1872 to 1882).
MADRAS	Government Astronomer	Meteorological observations made at the Hon'ble East India Company's Magnetical Observatory at Singapore in 1841 to 1845.
	Government of Madras	Annual Administration Reports of the Forest Department (Southern and Northern Circles) Madras Presidency, for the year 1882-83.
		Report on the measurement of rates of growth of Casuarina in the Nellore District.
MAGDEBURGH	Magdeburghischen Zeitung	Jahrbuch der meteorologischen Beobachtungen, Jahrg II, 1883.
MANCHESTER	Literary and Philosophical Society	Proceedings, Vols. XX to XXII.
		Memoirs, 3rd series, Vols. VII and IX.
MELBOURNE	Meteorological Observatory	Monthly Record of Results of Observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne Observatory from December 1883 to September 1884.
MEXICO	Central Meteorological Observatory.	Boletin del ministerio de Fomento de la Republicana Mexicana, Tomo IX, Nos. 1 to 64.
		Magnetical Observations, January to March 1884.
MILAN	R. Osservatorio Astronomico di Brera.	Osservazioni meteorologichi esequite negli anni 1875 e 1883.
		Sulle variazioni diurne del magnetismo terrestre resultati di osservazioni fatte a milano negli anni 1872 e 1877.
		Teoria degli stromenti ottici con applicazioni ai telescopi ed alla fotografia celeste.
MUNICH	Geographical Society	Jahresbericht der Geographischen Gesellschaft in München für 1882 and 1883.
	Publishers	Deutsche Rundschau für Geographie und Statistik, Vol. IV, No. 2; Vol. VI, Nos. 7 to 12.
	Royal Academy of Sciences	Sitzungsberichte der mathematisch-physicalischen Classe, 1883, Heft III; 1884, Heft I.
		Abhandlungen, Vol. XV, part I.
		Franz von Kobell. Eine Denkschrift.
		Gedächtnissrede auf Theodor L. W. von Bischoff.
NAGPUR	Chief Commissioner, Central Provinces.	Sugar cultivation in the Central Provinces.
		Report on the Nagpur experimental farm in the Central Provinces for the year 1883-84.
		Report on the Trade and Resources of the Central Provinces for 1883-84.
		Report on the Road side arboriculture in the Central Provinces for the year ending 31st March 1884.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—continued.

Place.	Donor.	Title of Work.
NAGPUR—*contd.*	Chief Commissioner, Central Provinces.	Returns of Rail-borne Traffic during the quarters ending 30th June and 30th September 1884.
		Third Wheat Forecast of the Central Provinces.
NEW HAVEN	Connecticut Academy of Arts and Sciences.	Transactions of the Connecticut Academy of Arts and Sciences, Vol. VI, part 1.
NEW YORK	Meteorological Observatory.	Abstract of registers from self-recording instruments, December 1883 to November 1884.
OXFORD	Radcliffe Observatory	Results of the meteorological observations made at the Radcliffe Observatory, Oxford, in the year 1881.
PARIS	Academy of Sciences	Mission Scientifique du cap Horn 1882-83, Rapports préliminaires.
	Bureau Central Météorologique de France.	Bulletin International, Vol. XXXVIII, Nos. 53 to 366, Vol. XXXIX, Nos. 1—57.
		Annales du Bureau Central Météorologique de France Année 1881, parts I, III and IV.
	Météorological Society of France	Annuaire, November 1883 to March 1884.
PERTH (WESTERN AUSTRALIA).	Surveyor General	Western Australia Meteorological Report for 1882.
PESARO	Meteorological and Magnetical Observatory.	Curves, April 1879 to December 1880.
PHILADELPHIA	Franklin Institute	Journal, February 1883 and March 1884 to February 1885.
PRAGUE	Imperial Observatory	Astronomische, magnetische und meteorologische Beobachtungen an der K. K. Sternwarte zu, Prag. in Jahre 1883.
RIO DE JANEIRO	Imperial Observatory	Bulletin Astronomique et météorologique, September 1881 to November 1883.
		Annales, Tomo II.
SANTIAGO	Observatoire Nacional	Observaciones Meteorologicas, 1873 to 1881.
SIMLA	Inspector-General of Forests with the Government of India.	Review of the Forest Administration in British India for 1882-83.
SINGAPORE	Colonial Surgeon, Straits Settlements.	Straits Settlements Meteorological Returns, 1883.
STONYHURST	Reverend S. J. Perry, F.R.S.	Results of meteorological and magnetical observations recorded at the Stonyhurst College Observatory during 1883.
ST. PETERSBURGH	Physical Central Observatory	Annalen des Physicalischen Central Observatoriums; Jahrg 1882.
		Repertorium für Meteorologie, Band VIII.
	International Polar Commission	Communications from the International Polar Commission, parts 5 and 6.
SYDNEY	Observatory	New Double Stars, H. C. Russell.
		Results of Rain and River Observations made in New South Wales during 1883.
		Physical Geography and Climate of New South Wales.
SYRACUSE	Osservatorio Centrale di Siracusa	Osservazioni meteorologichi, July 1882 and January to May 1884.
TASMANIA	Royal Society of Tasmania	Report of the Royal Society of Tasmania for the year 1883.
		Papers and Proceedings of the Royal Society of Tasmania for 1883.
TOKIO	Imperial Meteorological Observatory.	Meteorological observations recorded at Wakayama, August to December 1882, and at Aomori, Hiroshima, Kiôto, Kanasawa, Kochi, Nagasaki, Niigata, Nobiru, Osaka, Tokio and at Wakayama, during the year 1882.
		Monthly summary (March to December) and monthly means for the year 1883 with 37 maps.
	University	Measurement of the force of gravity.
TORONTO	Meteorological Office	Monthly Weather Review, February to December 1884.
		General Meteorological Register for 1884.
		Report of the Meteorological Service of the Dominion of Canada for 1882.

Presentations to the Library from the 1st April 1884 to the 31st March 1885—concluded.

Place.	Donors.	Title of Work.
Turin	Observatory	Bolletino dell' osservatorio della regia universita di Torino, 1883.
		Effemeride del sole, della Luna e dei principali Pianeti calcolati per Torino in tempo medio civile di Roma per l'anno, 1884 and 1885.
		Nuovo Materiale Scientifico e prime osservazioni con Anelli micrometrici all' osservatorio di Torino.
		Prime Osservazioni con Anelli micrometrici all' osservatorio di Torino.
Upsala	Observatoire Météorologique de l' université.	Bulletin mensuel, Vol. XV, Année 1883.
Vienna	Dr. J. Hann	Zeitschrift der oesterr Meteor. Gesellschaft, Band XIX, April to December 1884; Band XX January and February 1885.
	Dr. J. M. Pernter	Beitrag zu den Windverhältnissen in höheren Luftschichten.
	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.	Internationaler telegraphischer Wetterbericht, Vol. VIII, Nos. 42 to 366, Vol. IX, Nos. 1 to 41.
		Jahrbucher Neue Folge, Band XVII, Jahrg 1880; Band XVIII, Jahrg 1881; Band XIX, Jahrg 1882, Erster Theil.
		Anleitung zur Ausführung meteorologischer Beobachtungen an stationen II und III Ordnung.
		Jelineks Anleitung zur Ausführung meteorologischen Beobachtungen nebst einer Sammlung von Hilfstafeln.
	K. K. Geologischen Reichsanstalt	Verhandlungen, Nos. 1 to 18 of 1884; Nos. 1 and 2 of 1885.
Vizagapatam	A. V. Nursingrow, Esq., F.R.A.S., F.R.G.S.	Results of Meteorological Observations taken at the G. V. Juggarow's Observatory, Vizagapatam, during 1883.
Washington	Chief Signal Office	International meteorological observations, 1st January 1882 to 30th June 1883.
		Bulletin of International Meteorology, Summary, January to December 1883.
		Monthly Weather Review, February 1883 to December 1884.
		Memoranda on International Scientific Co-operation in Meteorology, Magnetism, &c.
		The use of the Spectroscope in Meteorological Observations.
		Report of the Chief Signal Officer, U. S. A. War Department, for 1879 to 1882.
		Professional papers of the Chief Signal Office, Nos. *VIII* to XII and *XIV*.
	Philosophical Society	Bulletin of the Philosophical Society of Washington, Vols. IV. to VI.
	Professor E. Loomis	Contributions to Meteorology, 20th paper. Reduction of barometric observations to sea-level.
	Smithsonian Institution.	Smithsonian Report for 1881 and 1882.
	United States Geological Survey	Second Annual Report of the United States Geological Survey for 1880-81.
	United States Naval Observatory	Meteorological observations made at the United States Naval Observatory during the year 1880.
		Report of the Superintendent of the United States Naval Observatory for the year ending 31st October 1884.
	W. Upton	Report of observations made on the expedition to Caroline Island to observe the total solar eclipse of 6th May 1883.
Wellington (New Zealand.)	Meteorological Office	Abstract of Meteorological Observations, New Zealand, for the quarters ending 31st December 1883, 31st March and 31st June 1884.
		Statistics of New Zealand, 1883 (Meteorology).
		Meteorological Report, 1883, including returns for 1880, 1881, 1882 and averages for previous years.
Zi-Ka-wei	Magnetical and Meteorological Observatory.	Bulletin Mensuel, July 1883 to March 1884, and year 1883.
		Les typhoons des mois de Juillet et Août 1882.
		The typhoons of 1882.
Zurich	Swiss Meteorological Institute	Schweizerische Meteorologische Beobachtungen, 1880 to 1882 and 1884.

Purchases for the Library.

American Journal of Science, March 1884 to February 1885.
Annalen der Physik und Chemie, Nos. 4 to 12 of 1884; and Nos. 1 and 2 of 1885.
Cartes Synoptiques Journaliéres du temps, le Nord de l'Atlantique et une partie des continents avoisinants; publiées par L'institut Météorologique Danois et le Deutsche Seewarte, 1er tremestre, December 1880 to February 1881, 2nde trimestri, March to May 1881; 3me trimestre, Juin to, Aout 1881.
Comptes Rendus de l'Academie des Sciences, Tome XCVIII, Nos. 9 to 26; Tome XCIX; Tome C, Nos. 1 to 8; and Tables for Tomes XCVII and XCVIII.
Deutsche Rundschau für Geographie und Statistik, Vol. VII, Nos. 1 to 6.
Dictionary of Chemistry, Vols. I to VIII.
Electricity and Magnetism—Jenkin.
Encyclopœdia Britannica, Vols. XVI and XVII.
Handbuch der Klimatologie—Hann.
Heat—P. G. Tait.
Instructions for testing lines, batteries and instruments, and guide to the technical arrangement of Telegraph Offices in India, Vols. I and II.
Joule's Scientific papers, Volume I.
La Nature, Nos. 563 to 614.
Nature, Nos. 750 to 801.
Nature of Light—G. G. Stokes.
Papers on Electrostatics and Magnetism—Sir W. Thomson.
Philosophical Magazine, March 1884 to February 1885.
Repertorium der Deutschen meteorologie—Hellman.
Report of the British Association for the Advancement of Science for 1883.
Roorkee Hydraulic Experiments, Volumes I to III.
Sound—Tyndall.
Text Book on the Principles of Physics—A. Daniel.

Government of India, Central Printing Office.—No. 30 Meteor.—5-10-85.—400

REPORT

ON

THE ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA

IN

1885-86.

PART I.—GENERAL.

IN accordance with the practice of recent years, I preface the report on the detailed administration of the department, with a notice of some of the more important subjects to which attention has been directed during the past year.

ACTINOMETRIC OBSERVATIONS.—In the reports for three previous years, I have recounted the history of my endeavours to obtain more exact measures of the solar heat than had been practicable in the atmosphere of either Europe or India. With that object, Sergeant Rowland, who had been selected and sent out by the Secretary of State in 1882, after undergoing a thorough training at Dehra under the direction of Mr. J. B. N. Hennessey, was despatched to Leh in October 1883, together with a trained assistant. In last year's report, I had to relate how, owing to the adverse conditions of the climate, the results had fallen far short of our hopes and expectations, and I gave a tabular return of these results, amounting up to the end of March 1885, to 52 complete and 64 incomplete ordinary daily series of observations, and 6 complete and 14 incomplete long series.

The observers remained at Leh, continuing their work until the beginning of October 1885, and during the further interval of six months, obtained the following additions to their previous registers:—

Months.	Daily complete.	Series incomplete.	Long complete.	Series incomplete.
April 1885	...	2	...	...
May „	...	1	...	...
June „	3	5	...	1
July „	5	9	1	...
August „	...	9	...	...
September 1885	...	5	...	...
Total of six months	8	31	1	1
„ previous 17 months	52	64	6	14
„ whole period	60	95	7	15

The complete series of the final six months fell therefore considerably short even of the previous average, and it would obviously have been useless to prolong the experience. Sergeant Rowland and his assistant were therefore instructed to withdraw from Leh, at the end of the season, in time to ensure their reaching India before the closing of the passes. They left accordingly on the 3rd October and reported their arrival at Dehra on the 9th November, bringing back their instrumental equipment, which was then made over to the charge of Colonel Haig, Deputy Surveyor General in charge of the Dehra Office.

The instruments were in excellent order, and will be available for future work. Under the sanction of the Government, the services of Sergeant Rowland have been transferred to the Survey Department to carry on the work of solar photography, with the large heliographs provided for this purpose at Dehra. The assistant, Mr. H. Shaw, has been since employed carrying on the actinometric observations at Dehra and Mussooree, also under the direction of Colonel Haig. It is probable, judging from Mr. Hennessey's former experience, that, notwithstanding the lower elevation of this station and Mussooree, they will be found at least as well fitted for the work as Leh, while they offer far superior advantages in point of climate and accessibility.

The results of the 23 months' work at Leh have been sent home to the Solar Physics Committee for examination and discussion, copies being retained in this country. It may be hoped that, notwithstanding that they fall far short of what had been expected, they may still be found to yield information of much value. I have every reason to believe that they have been taken with the greatest care and attention to accuracy, in accordance with the elaborate system devised by Mr. Hennessey, and that all has been accomplished that could be accomplished by careful training, and assiduous devotion to the work on the part of the observers. Of their conduct during their two years' residence in Leh, I cannot give a better idea than to quote from the certificates forwarded by Sir Oliver St. John, Her Majesty's Resident in Kashmir, with the request that their excellent conduct may be brought to the notice of the Government of India. The Wazir of Ladak, Radha Kishen, writes to Sir O. St. John: "During two years of their stay here, for the greatest part of which their immediate superior, the British Joint Commissioner, was away, they always conducted themselves to my entire satisfaction . . . . They leave this country with my best wishes, and I hope that their good conduct and hard work in such a severe country as Ladak, where they have spent two winters continuously, will be the means of their advancement in their future employment." And Mr. Ney Elias, the British Joint Commissioner, observes: "I cannot leave this Agency without recording my good opinion of Sergeant Rowland . . . . For several months, during the absence of the Political Agent, he has carried on the current duties of the Agency Office. The way in which he has conducted himself throughout has been most creditable . . . . He has done his own duty, has got on well with the native officials and people of the country, and might be trusted to act with judgment and good sense in any independent position in a foreign country . . . . I hope his good services and admirable conduct will be duly recognised by the authorities at home."

SUNSHINE RECORDS.—During the past year, instruments for recording the duration of sunshine have been furnished to Lahore and Nagpur, making, with those already provided with them in previous years, five stations at which this important meteorological

element is now the subject of regular registration. The other stations are Calcutta, Allahabad and Jeypore, where these records are now available for the following periods :—

Allahabad	since April 1882.
Calcutta	„ January 1883.
Jeypore	„ February 1884.

I offered in March last to supply an instrument to the Colaba Observatory, Bombay, but it has been declined by the Superintendent. It has therefore been sent to the Meteorological Reporter for Western India, whose office is situated at the Observatory, with instructions to obtain a regular register by its means.

GROUND TEMPERATURE.—A set of thermometers for registering the temperature of the ground, at the surface and at different depths of a few feet, (within the zone subject to an annual oscillation of temperature) has been furnished during the past year to Lahore. Observations of this kind have now been recorded under a similar arrangement for some years at Calcutta, Allahabad, Dehra and Jeypore, *viz.*:—

Calcutta (Alipore) . .	since April 1878.
Allahabad	„ May 1880.
Dehra	„ June 1881.
Jeypore	„ August 1881.
Lahore	„ August 1885.

These registers testify uniformly to the fact that, the ground is on an average from 3 to 5 degrees warmer than the air; the difference varying, however, with the time of year and also with the depth. It varies moreover, in some small degree, from year to year according, as would appear, to the relative prevalence of sunshine and rain. It appears that the ground acts as a store-house of solar heat, which penetrates to a depth the limits of which are not yet ascertained in India, and is gradually given out again to the superincumbent air. At Calcutta, the registers have established the important fact that, the temperature of the alluvial soil increases rapidly downwards, (at the rate of about 1° in 2 feet for the first few feet) indicating the existence of a permanent source of heat within a short distance of the surface. This source is probably to be found in a layer or layers of decomposing organic matter, sometimes reached in deep excavations for tanks, &c.

As the result of a long series of observations on the temperature of the rock of Calton Hill, Edinburgh, it has been thought probable that the variations of the ground temperature, from year to year, would serve as an indication of those of the solar heat. This, however, seems very doubtful. It is evident that the ground temperature is largely modified by rain and its subsequent evaporation, and it is unlikely that a much smaller temperature variation, arising from the assumed variability of the solar radiation, would be discoverable in the registers of any moderate period.

FIRST CLASS OBSERVATORIES.—There have been hitherto only three observatories in India, fully equipped with autographic instruments, for furnishing either a continuous register, or one repeated at short (ten minutes') intervals. These were the Government observatories at Calcutta (Alipore) and Bombay, and the Maharajah's observatory at Jeypore. During the past year, a fourth has been established at Allahabad, and a portion of the instruments for a fifth at Lahore, were received shortly after the close of the year, a suitable building having been already provided.

The new Allahabad Observatory is situated in the large open space known as the Chatham lines—a site admirably fitted for the purpose. The building has been erected for

the accommodation of the observatory and the Meteorological Reporter's Office at an estimated cost of R13,000 and is therefore especially adapted to the proper exposure and working of the instruments. The autographic instruments consist of a Van Rysselberghe's meteorograph (the duplicate of that at Jeypore). It is worked by clock-work and electricity, and records at intervals of 10 minutes, the readings of the barometer, the wet and dry bulb thermometers, the duration of the wind, and also the distance travelled by the wind and the amount of rain that may have fallen in the previous ten minutes. All these are engraved on a zinc plate, graduated by the instrument while in the act of recording the reading, which, after removal from the instrument, is etched, and may then be printed from, and made to furnish any required number of copies of the register.

The instrument was set up and began to work in the beginning of March 1886. It will take some little time to accustom the observatory staff to the management of this new, somewhat complex and delicate instrument, and hitherto there have been occasional interruptions in its working. With increased experience and under Mr. Hill's guidance, it may be confidently expected that all difficulties will be eventually surmounted.

The similar meteorograph which was originally intended for the Lahore Observatory, having been disposed of to the Maharajah of Jeypore, it has not been thought desirable to obtain another for Lahore, where the difficulty of adjusting and managing it would have been much greater. And therefore a set of self-recording instruments will be supplied, which are simple in principle, independent in their action, and which register mechanically. Those for recording the atmospheric pressure, temperature and humidity, are the invention of Dr. Draper, and are similar to those which have long been in use in the New York Observatory. Those for rainfall and wind registration are the invention of Mr. Beckley and similar to those used at Kew and also at the Alipore Observatory in Calcutta. These latter are already in India.

The removal of the Lahore Observatory from the Mayo Hospital to a building nearly 4 miles distant, on the outskirts of Anarkalli, at the beginning of 1885, necessitated that observations should be recorded simultaneously at the old and new sites, sufficiently long to show what change in the apparent normal or average temperature, humidity, &c., of Lahore has been caused by the removal. These observations were carried on during 1885, and will be continued up to the end of 1886. There will then be two entire years' registers available for comparison, and these should suffice to show what corrections must be applied to the registers of past years to render them comparable with those of the present and future years.

RAINFALL STATISTICS.—Some further additions of importance have been made, during the past year, to the stations transmitting regular returns of the rainfall to the Central Office.

Most of these are due to the extension of rainfall registration in Rajputana, through the exertions of Dr. Hendley, Residency Surgeon at Jeypore; and some are of especial value, as representing the arid region of Western Rajputana, which, but a few years since, was an almost complete blank on the charts of recorded rainfall. The following are the newly-established stations:—

Bandikui.	Jhunjhnu.
Lalsot.	Sri Madhopur.
Siwai Madhopur.	Sikar.
Malpura.	Khetri.

Another important addition is that of Kelat in Beluchistan, and a third that of Pedong in Bhotan.

Including observatories, rainfall registers are now received from 484 stations in India and its dependencies, including Ceylon and other islands.

SNOWFALL REPORTS.—Reports of the snowfall on the mountains of the north-western and northern frontiers were received during the spring of 1885 from the following officers:—

The Deputy Commissioner of Bannu.	The Assistant Commissioner of Kulu.
„ „ „ Dera Ismail Khan.	„ Revd. A. W. Heyde, Kailang, Lahoul.
„ „ „ Kohat.	„ Collector of Kumaon.
„ Political Agent, Khyber.	„ Assistant Commissioner of Garhwal.
„ Assistant Commissioner of Eusufzye.	„ Civil Surgeon of Mussooree.
„ Deputy Commissioner of Peshawar.	„ Deputy Commissioner of Darjeeling.
„ „ „ Rawalpindi.	„ „ „ Kamrup.
„ „ „ Kangra.	„ „ „ Darang.

In many of the reports there was a considerable improvement on those of the preceding year, and those of the Deputy Commissioner of Kohat, the Assistant Commissioner of Kulu, and one or two others gave much useful information, collected from travellers and traders, as to the depth of snow on the passes and hills beyond the frontier. The Reverend A. W. Heyde's reports are also especially valuable as those of an intelligent observer, resident for many years in the inner Himalaya.

During the present cold weather and spring, reports have been received regularly from the same officers.

FORECAST OF THE MONSOON.—An attempt to estimate the prospects of the monsoon rains, based on the results of the snowfall reports and the general character of the winds and pressure distribution in the period immediately antecedent to the rainy season, has been made in each of the last two or three years. In 1885, the indications on which this forecast was based, were of a more pronounced character than in either of the previous years, and the prediction which they seemed to justify, *viz.*, that the influx of the monsoon rains, on the west coast and in Southern and Western India generally, would be retarded, was so amply borne out by the subsequent history of the season, that my confidence in the general validity of the method has been very much strengthened.

In a memorandum, dated 21st May, it was reported that "the snowfall on the Himalaya appears to have been universally heavy during the past season, and it has received continual additions up to the present time;" that "the unusual weather of April and May had made large additions to the snows of the North-West Himalaya, preserving thick snow-beds down to 11,000 feet, even on the outermost hills, and mantling the higher ranges with an unbroken sheet of snow." From Kailang in Lahoul, the Reverend A. W. Heyde had written on the 4th May: "This is a very extraordinary spring, cold and exceedingly wet for Lahoul. On the northern slopes the fields are still covered with about 1½ feet of snow at this moment, which is altogether unusual for this part of Lahoul," &c. It was pointed out that the weather in the Punjab and, in a minor degree, all over Western India, had been unusually cool, and the barometer persistently high; that "owing to the coolness, the excess of pressure has been much greater on the plains than on the mountains; and greater in North-Western India, than to the east and south;" "more or less, the

pressure has been above the average all over India, and although subject to marked oscillations, the average remains unusually high."

"Under such circumstances as these, west and north-west winds are always very prevalent in North-Western and Western India, and this has been the case during the present month (May). In some years they are most persistent in Northern India, blowing down the Gangetic plain and across Rajputana and Central India towards Bengal and Orissa. In other years they blow more steadily down the western side of the peninsula, in the Konkan and Western Deccan. The latter appears to be the case in the present year. . . . . Coming from a cool region, where there is little evaporation, these winds are always dry, and in proportion as they prevail, to the exclusion of the ordinary monsoon from equatorial seas, so is the season dry or wet . . . . Any condition that unduly raises the barometric pressure in North-Western India and on the Himalayas, and in Afghanistan and Beluchistan, favours the north-west winds. And since rain on the plains and unusual snow on the hills keep the air cool and heavy, they afford such a condition. But, if this depends on the extent of the Himalayan snows alone, it is not very lasting, although it may operate for some weeks."

Having thus traced out the grounds and principles on which the forecast was based, the conclusion was put forward in the following terms:—

"At present it would appear that the influx of the monsoon rains, on the west coast and in Southern and Western India generally, is likely to be retarded, and it is this branch of the monsoon that brings the greater part of the rainfall to the peninsula, Central and Western India. But in 1876, 1877 and the earlier part of 1878, the barometer was high over a large part of Asia, owing to some cause or causes as yet unknown; and this undoubtedly was one cause of the severe droughts of those years . . . . As far as our information goes, there is no reason for anticipating more than a retardation of the rains of the west coast."

"If the conditions remain as at present, there is no reason to anticipate any retardation of the monsoon on the Bengal side as well, but the only ground, at present, for forming a judgment on this point, is that there is a certain persistency in the weather phases of India; and that as the north-west winds seem at present to hold down the west of the peninsula, rather than across Northern India, there is a balance of probability in favour of their remaining so."

How far this forecast was realized, will best be shown by the following extracts from the monthly summaries of the weather, based on the telegraphic reports, and the preliminary report on the meteorology of the year, drawn up by Mr. Dallas, from the tabulated results of all the meteorological stations.

In the weather summary for June it is stated that the rainfall "has been distinguished by two noticeable characteristics: in the first place, the fall has been accompanied by a very unsteady monsoon current, while in the second place the extent of the fall has been greatly restricted. In Bombay itself, the burst of rain which usually characterizes the setting in of the monsoon on the Konkan coast has not occurred during the month, and the winds over that region appear to have been abnormally dry; and further to the southward, *i.e.*, on the Malabar coast, though the winds appear to have brought up the normal amount of moisture, it seems to have been deposited only on the western face of the Ghâts, and the stations on the Deccan and Hyderabad show a great deficiency of rainfall. The

weather in the Berars, Khandesh and Guzerat has been similar to that prevailing in the Konkan, the winds having been unusually dry."

In Bengal[1] "on the 16th, a small depression was formed over the Sunderbuns; and as this little disturbance travelled, first westward and subsequently north-westward, the rains extended up the Gangetic plain, and by the 24th has set in over the greater part of the North-West Provinces. On the 26th, a second depression was formed over the Sunderbuns, and this disturbance travelling westward in its turn, fairly established the rains over the North-Western Provinces and as far west as Delhi and the east of the Punjab."

In the report for July it is stated "heavy rain fell at Mangalore on the 1st. This proved to be the beginning of a burst of rather heavy rain on the west coast, lasting until the 9th and spreading northward as far as Ratnagiri, without however reaching Bombay." . . . On the 17th, a fall of six inches occurred at Bombay, and larger amounts on the neighbouring hills. This was the first downpour of the season on the Konkan coast, and resulted in extensive floods in the neighbourhood of Bombay . . . . In the eastern and central parts of the peninsula, the normal westerly winds appear to have been exceptionally dry; and Mysore, Bellary and the Carnatic had even less than the small average rainfall. Further north, in the Northern Circars, Orissa, Chutia Nagpur and Lower Bengal, there has been a slight deficiency; but in Assam, Cachar, Northern Bengal and over the whole of the North-Western Provinces and Oudh, the rainfall has been excessive . . . . The figures for the season, up to date, show that the rains have been unfavourable in two regions—one includes the Konkan, Khandesh, and the Bombay Deccan, where the amount of rainfall for the two months, June and July, has been only from $\frac{1}{5}$ to $\frac{1}{2}$ the average amount, and the other the Punjab. In all other parts of the country the seasonal average has been fairly well maintained.

In August "during the first ten days the rainfall on the west coast was insignificant; but on the 12th it became heavier, . . . and during the week following, heavy showers fell at the majority of the peninsular stations." In the region under the influence of the Bengal branch of the monsoon, the weather was practically the same as in the preceding month.

From these reports, the general tenor of which is fully borne out by the more abundant data since received, it appears that the terms of the forecast made on the 21st May were very amply justified by the results.

TRUE CHARACTER OF THE MONSOONS.—Any successful attempt to forecast the prospects of the monsoon, or even to give a rational explanation of the variations which it has manifested, must be based on a true conception of its normal characters and its real nature. The description of the summer monsoon, which appears in most treatises on the subject, and which therefore represents the ideas most prevalent among well-informed persons, may be summarized somewhat as follows :—

The summer monsoon is regarded as an anomalous diversion of the south-east trade wind of the South Indian Ocean. Owing to the high temperature developed in the continent of Asia in the early summer months, and the consequent lowering of the atmospheric pressure, instead of a trade wind setting from the northern tropic towards the equator,

[1] The average date for the setting in of the rains in Bengal is the 15th June. At Bombay it is usually estimated a few days earlier.

as is the case in the Atlantic and Pacific Oceans, the south-eastern trade of the South Indian Ocean is prolonged across the equator and drawn onwards to Southern Asia as the south-west monsoon. This wind is saturated with vapour taken up from the expanse of sea over which it has passed, and the vapour is discharged as rain on India, the Malay Peninsula and China, in the rainfall of the summer monsoon.

This view, while true as a first rough sketch of the facts, is in a certain measure erroneous; firstly, as an over-statement of fact, and secondly, regarded from another point of view, it is defective, inasmuch as it leaves unexplained the existence of a rainless or almost rainless region in Western India, and on the coast of Beluchistan; and also it affords no means of accounting for such vicissitudes of the monsoon rainfall as characterized the past year, and in a far more intense degree the year 1876.

In the first place, it is an over-statement of fact. The wind charts of the North Indian Ocean, now in course of preparation, show that the south-east trade, does not, as a rule, blow across the equator, and, changing its course from south-east to south and finally to south-west, pass gradually into a south-west monsoon. That it does occasionally do so is unquestionable, but such is rather the exception than the rule. A rainy belt in the neighbourhood of the equator exists throughout the year, which is fed by the south-east trades. In this belt, the winds are very variable, blowing from all quarters, from west-north-west round to south; and it is only some 6° to the north of the equator that the monsoon is established as a comparatively steady current of wind. The monsoon therefore, (in so far as it is a *south-west* monsoon,) is drawn from a reservoir of air over the equatorial zone, fed by the south-east trades, but it is not the south-east trade wind simply diverted from its former course. And the distinction is an important one.

Moreover, the Indian summer monsoon is not simply a *south-west* monsoon; and herein the prevalent view is defective in an important particular. On the Arabian Sea, and especially beyond the tropic, the winds are as frequently west as south-west and not infrequently north-west, and this is also the case on the west coast of India. The less southerly or the more northerly the wind, the finer is the weather, and the smaller the rainfall of the Bombay Presidency. The explanation of these facts is that, at certain times, a considerable portion of the air which enters into the western branch of the monsoon is not drawn from equatorial regions at all, but from the dry coasts or still drier plains and mountains to the north. In all years, in the summer season, this dry air furnishes the greater part of the winds of the Lower Indus Valley and Western Rajputana, and hence the rainlessness of this portion of Western India. And according to the variation of atmospheric pressure over the continent of Asia, so does it enter in larger or smaller proportion into the wind current which sweeps the northern half of the Arabian Sea, and carries drought, either temporary or prolonged, to Guzerat, Khandesh or the Deccan.

These corrections of the prevalent conception of the character of the summer monsoon have therefore a practical bearing of very considerable importance. The next step towards an explanation of the causes of drought and famine will be to ascertain, if possible, what circumstances favour and what are adverse to the extended prevalence of the dry northerly element of the monsoon. These have been briefly alluded to in the forecast of the monsoon of 1885, quoted on a preceding page; there are now very good grounds for believing that an unusual extent of snow on the mountain tract of Beluchistan, Afghanis-

tan and the North-Western Himalaya favours the dry northerly element of the monsoon. But there are also grounds for believing that this cause and therefore its effects are not very lasting, and that great droughts, such as those of 1876 and 1877, depend on atmospheric conditions of much wider prevalence.

INFLUENCE OF FORESTS ON CLIMATE.—*Forest Observatories.*—Some time before Dr. Brandis's retirement from the office of Inspector General of Forests with the Government of India, he consulted me on the establishment of observatories in connection with the forests, with a view to ascertaining the effect of forests, more especially on temperature and rainfall. Observations of this kind have been made somewhat extensively in Europe, and the work of Ebermeyer[1] on the results of five years' systematic observations, at comparative observatories (within and without the forests) in Bavaria, is a well-known standard treatise on the subject.

As the result of this consultation, the first step taken in the Forest Department was to establish an observatory at the Forest School at Dehra-Dun, which should serve as a model for the forest observatories and a training school for observers. Arrangements were made, by Dr. Warth, for recording temperature, the humidity of the air and the rainfall near the ground and also 66 feet above it, and these observations have been carried on regularly, from October 1882 up to the present time.

In July 1884, the first pair of comparative observatories was started at the Forest Nursery, Ajmere; they were less complete in plan than the Dehra model, sheds of similar pattern being erected under the trees of the forest and in the open ground outside the forest; and readings of the maximum, minimum and 10h. and 16h. temperatures were recorded with thermometers therein exposed, the instruments having been previously verified at the Alipore Observatory. In this case, rainfall was recorded only outside the forest.

In August 1885, another pair of observatories, similarly furnished, was established at the Mohwa Bir Forest, Ajmere, and from the beginning of the present year (1886) comparative measurements of rainfall have been made both within and without six forests in the Ajmere-Merwara reserves.

In June 1884, comparative observatories were established in the Dun at the Ramgarh forest, and in March 1885, a similar pair in the Rajah's forest, by Mr. Fisher, the Director of the Forest School. These are on the same plan as the model observatory at the Dehra Forest School; observations of temperature, humidity and rainfall being recorded both near the level of the ground and also at an elevation of 60 feet above it, on a structure originally designed and constructed by Dr. Warth.

The results of these observations, so far, seem to show slightly but appreciably higher rainfall in the forest than without. Before, however, this can be accepted as a valid generalization, unquestionably a careful enquiry must be made into the possible existence of other circumstances affecting the contents of the rain-gauge, besides that obvious difference of position, the effects of which is the aim and object of the observations to gauge;[2] but it is certainly noteworthy that the large majority of the comparative

[1] Die Physikalischen Einwirkungen des Waldes auf Luft und Boden. Dr. Ernst Ebermeyer. Wiegaudt; Hempel und Paery, Berlin, 1873.

[2] One precaution that I have recommended to the Director of the Forest School is for the ensuing year to exchange the gauges and measure-glasses used respectively inside and outside the forest.

observations up to the present time seem to point out in the same direction. They are as follow:—

Comparative measurements of rainfall within and without forests.

RAMGARH FOREST, DEHRA DUN.

	Rain-gauges on ground,			Rain-gauges 60 feet above ground.		
	I In forest.	O Outside.	Difference. I—O	I In forest.	O Outside.	Difference. I—O
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
June (16th—30th) 1884	4·07	3·66	0·41	3·88	3·61	0·27
July 1884	26·46	25·64	0·82	26·44	24·72	1·72
August „	21·74	21·18	0·56	21·23	19·88	1·35
September „	18·78	17·53	1·25	18·01	17.19	0·82
October „	0·39	0·28	0·11	0·37	0·26	0·11
November „	0	0	0	0	0	0
December „	0	0	0	0	0	0
January 1885	4·48	4·20	0·28	4·63	4·56	0·07
February „	0·70	0·85	—0·15	0·67	0·77	—0·10
March „	0·39	0·48	—0·09	0·36	0·42	—0·06
April „	0·55	0·44	0·11	0·50	0·45	0·05
May „	5·99	5·35	0·64	5·79	5·06	0·73
June „	10·76	10·31	0·45	10·61	9·75	0·86
July „	9·90	9·81	0·09	9·88	9·27	0·61
August „	44·91	44·64	0·27	44·45	43·56	0·89
September „	5·51	6·24	—0·73	5·47	6·06	—0·59
October „	0	0	0	0	0	0
November „	0	0	0	0	0	0
December „	3·49	3·45	0·04	3·52	3·48	0·04
Totals	158·12	154·06	+4·06	155·81	149·04	+6·77

RAJAH'S FOREST, DEHRA DUN.

	Rain-gauges on ground,			Rain-gauges 60 feet above ground.		
	I In forest.	O Outside.	Difference. I—O	I In forest.	O Outside.	Difference. I—O
	Inches.	Inches.	Inches.	Inches.	Iuches.	Inches.
April 1885	0·42	0·06	0·36	0·36	0·32	0·04
May „	3·99	4·69	—0·70	4·04	4·36	—0·32
June „	11·70	10·47	0·23	11·42	10·07	0·35
July „	10·63	9·81	0·82	9·58	9·47	0·11
August „	45·87	47·50	—1·63	45·87	46·99	—1·12
September „	2·46	2·43	0·03	2·41	2·40	0·01
October „	0	0	0	0	0	0
November „	0	0	0	0	0	0
December „	3·54	3·40	0·14	3·45	3·43	0·02
Totals	78·61	78·36	+0·25	77·13	77·04	+0·09

AJMERE-MERWARA FORESTS.

	Mohwa Bir.			Madar Hill.			Nag Pahar.		
	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.
January 1886	0·10	0·08	0·02	0·15	0·12	0·03	0·08	0·05	0·03
February „	0·04	0·03	0·01	0·02	0·02	0	0	0	0
March „	0	0	0	0	0	0	0	0	0
Totals .	0·14	0·11	0·03	0·17	0·14	0·03	0·08	0·05	0·03

	Danta.			Rajgarh.			Dilwara Bir.		
	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.	Inside.	Outside.	Difference.
January 1886	0·30	0·32	—0·02	0·35	0·25	0·10	0·08	0·07	0·01
February „	0·05	0·04	0·01	0	0	0	0	0	0
March „	0	0	0	0	0	0	0	0	0
Totals .	0·35	0·36	—0·01	0·35	0·25	0·10	0·08	0·07	0·01

The obvious tendency of these results is to show that the existence of forest increases the rainfall; and although, at present, the evidence is very far from conclusive, I should be by no means surprised if this tendency is confirmed by further and more rigorously conditioned experience. Even admitting this, it may however be contended that the differences shown are but small, appreciable but not important. But this would be a hasty and unwarranted conclusion. The pairs of observatories contrasted are, it must be remembered, in near proximity to each other, in all cases probably less than a mile, in some less than a quarter of a mile apart; and the influence of a forest, if real, does not abruptly end at the boundary of the forest tract, but must extend to a certain distance beyond its borders; while, for some distance within those borders, it is weakened by the proximity of the open country. Hence, any difference that may be shown by these pairs of stations in respect of rainfall, in so far as it is dependent on the presence or absence of forests, is probably considerably less in amount than would be shown, were it possible to contrast the rainfall of a large area under forest with that of the same area denuded and brought under cultivation. But it is almost impossible to institute a valid comparison of such areas on the large scale, because we can never be sure that the results are unaffected by conditions other than those which are the especial subject of the test.

If such influence is real, it may be confidently expected that the effects will be much greater in India than in Europe or most extra-tropical countries; such being the rule in the case of those meteorological actions that bear most affinity to that in question. I may cite, as an illustrative instance, the very remarkable diurnal variation of the rainfall shown by the Calcutta registers. In extra-tropical countries, any variation of the rainfall

according to the time of day is but small, and to be detected only on the comparison of a very long series of registers. But, in Calcutta, it is so marked as to be a subject of ordinary observation; and the registers of no more than seven years suffice to show that, in the hot season, the rainfall at 7 P.M., the hour of maximum, is more than twenty times as great as at 6 A.M., which is that of minimum rainfall.

The question of the influence of forests on rainfall has lately been made the subject of a very interesting paper by the eminent Russian Meteorolgist Mr. A. Woeikoff. In this, he draws largely upon India for evidence in support of his view, which is substantially that which I am myself inclined to regard as probable. In some cases, doubtless, the want of local knowledge has led him to over-estimate the effect of forest, and to treat as comparable, with reference thereto, instances which are largely affected by other conditions, such as exposure to winds from a dry quarter, to the prevalence of swamps, and the influence of hills. Owing to this defect in the selection of evidence, his conclusions have not commanded that general assent, to which they may perhaps hereafter be entitled. For this, we must look to a critical discussion of the further data which our Indian rainfall records are now yielding, and to more extensive observation, under the rigorous conditions of scientific experimental enquiry, which it may be within the power of the Forest Department to carry out. But speaking for myself, I must admit that, as the result of the extended experience and enquiry of late years, I have been more and more impressed with the growing evidence in favour of the view which Mr. Woeikoff advocates, and while I must necessarily admit that crucial and convincing proof is still wanting, the general tendency of the evidence is so decidedly favourable, that I can hardly regard the long-suspected influence of forests on rainfall as a question of equally balanced probabilities.

Mr. Ribbentrop, the Officiating Inspector General of Forests with the Government of India, has lately drawn my attention to a case of an apparent increase of the rainfall in consequence of forest protection, which is certainly striking, although like other cases of the kind, defective in some particulars as evidence and therefore not decisive. In preparing the data for the chart of the average rainfall of India, published in 1883, I had noticed that, the rainfall average of most stations in the Central Provinces was somewhat higher, if derived from the previous 10 or 12 years, than when obtained from longer periods; but as very little is known of the circumstances under which the registers had been kept, I attached no special meaning to the fact. A few months since, however, Mr. Ribbentrop, starting from the fact that extensive tracts of forest, previously devastated by jungle fires with a view to the nomadic system of cultivation practised by the hill tribes, had been brought under protection in 1875, and that thereby the area of vigorous forest growth had been enormously increased, was led to enquire whether this measure had sensibly affected the rainfall, and applied to my office for such records as might throw light on the subject. Comparing the rainfall of the years subsequent to 1875 with that of the years anterior to that date, he finds that the former, in all or nearly all cases, largely exceeds the latter, and he attributes this increase to the preservation of the forests.

The region which must be chiefly affected, supposing that forest protection has really had the influence attributed to it, would be the Satpura, the hilly tract that runs across the Central Provinces between the Nerbudda and the plain of Nagpur and Raipur. For this region, we have complete rainfall registers extending from 1865 or 1867 up to the present time, at the stations enumerated in the following table. I have taken the average

of the annual rainfall from the 9 to 11 years ending with 1875, and also that of the subsequent 10 years. The comparison of the two is shown in the following table :—

	Forests unprotected.		Forests protected.		Increase of annual average.
	Period.	Average rainfall.	Period.	Average rainfall.	
		Inches.		Inches.	
Badnur	1867—1875	39·83	1876—1885	47·83	+8·00
Chhindwara	1865—1875	41·43	1876—1885	48·48	+7·05
Seoni	1865—1875	52·07	1876—1885	54·76	+2·69
Mandla	1867—1875	53·58	1876—1885	56·32	+2·74
Burha	1867—1875	64·51	1876—1885	71·65	+7·14
Bilaspur	1865—1875	41·85	1876—1885	54·81	+12·96
Raipur	1866—1875	51·59	1876—1885	54·41	+2·82
Average		49·27		55·47	+6·20

The rainfall registers of Jubbulpore at the northern foot of the Satpuras, and that of Nagpur on the south, the one extending over 40 years, the other over 37 years, show that the average rainfall of a station, if derived from a period of 10 years only, has a probable error of 5 per cent., or of between 2 and 3 inches in the case of the stations enumerated. Further, it appears from a tabular summary of the rainfall of India since 1864, that the annual average of the whole country, for the 10 years, 1876-1885, was 0·66 inch greater than that for the 11 years, 1865-1875. About half the average difference shown in the above table of the Satpura stations must then be deducted, before we are justified in regarding the increase as even probably the result of some cause locally operating. The residue may fairly be regarded as indicating some such cause, but having regard to our ignorance of the circumstances under which most of the rainfall registers have been kept, it could hardly be confidently asserted that that cause is the conservation of the forests, and no other. Nevertheless, the facts, if not logically convincing, at least may be regarded as an addition of some importance to the accumulating evidence bearing on the subject.

The False Point Cyclone.—*Extension of the Bengal Storm-warning System.*—On the 22nd September 1885, a cyclone, small in extent but accompanied by high storm wave, devastated the settlement of Hookeytolla at False Point in Orissa. The terrible destruction of life and property which resulted from this storm, aroused public attention to the subject of storm warnings to the coast ports, and has led to the adoption of measures for extending the system, which had been devised mainly, if not exclusively, for the protection of the port of Calcutta.

It appeared from the experience of this storm, which was one of remarkably rapid progress, that a system of weather telegraphy which furnishes only one set of reports daily, though probably, in all cases, sufficient to admit of the coast ports being warned that a storm exists over the Bay, and even to assign its approximate latitude, is insufficient to allow of any precise determination of its probable course, and therefore of the issue of

special warnings to that part of the coast which may be more immediately threatened by its onset. And although it is usual, on such occasions, to call for extra telegrams from certain stations, if the advance of a storm is rapid, these extra reports may not be received in time to allow of a further warning being issued on them, before the storm bursts on the coast.

It has, therefore, been arranged that, whenever the telegraphic reports show that a storm is in existence over the Bay, an intimation to that effect shall be sent to the Port Officers of the chief ports on the Indian coast, and that they be instructed to depend on their own observations of the wind and barometer, for taking such precautions as the approach of the storm may render necessary; it being understood that, although further warning will be sent if possible, the absence of such warning is not to be understood as implying the absence of danger. This system in now is operation.

FLOOD WARNINGS, BOMBAY.—The plan, adopted in 1884, of communicating to the district officers and Political Agents of Khandesh and Guzerat, warnings of heavy rain in the drainage basins of Tapti and Nerbudda, and also of the approach from the Bay of Bengal of storms likely to produce such rainfall, with a view of forewarning them of floods in these rivers, has been in operation during the past season.

On the 18th June the following telegram was sent to the Collectors of Ahmedabad, Kaira and the Panch Mehals, and to the Political Agents of Rewa Kantha and Mahi Kantha: "Small storm moving westwards from Bengal. May possibly bring heavy rain to Guzerat." And on the 20th, when the storm had reached the neighbourhood of Sambalpur, further notice was sent by urgent telegram to the Collectors of Khandesh, Surat and Broach, and to the Agent of the Governor General, Baroda. The Superintendents of certain Observatories in the Central Provinces were at the same time warned by telegraph to report direct by telegraph to the above officers, if heavy rain (exceeding 3 inches in the 24 hours) should be registered. This storm, however, did not travel further westward, and there was consequently no flooding of the western rivers.

On the 28th June another storm was reported. This was formed about the Sandheads on the 26th, and on the 27th and 28th, travelled rapidly towards Allahabad, pursuing therefore a much more northerly course than its predecessor. It produced a very heavy fall of rain (6 inches) at Hoshangabad, and this was at once telegraphed to the officers in Guzerat, but the storm continued its course towards the Upper Provinces, and soon after broke up. There were no floods of a disastrous character in the Western Presidency, and indeed drought and not flood was the characteristic of the season.

MARINE METEOROLOGY.—The charts of barometric pressure, winds and currents in the Bay of Bengal for each month of the year, having been recast in accordance with suggestions received from the Officers and Weather Institutes that had been consulted, as reported last year, have been lithographed, and those for several months have now been printed off. The complete work will, it is hoped, be issued in the course of the present year.

Good progress has been made with the preparation of similar charts for the Arabian Sea, and Mr. Dallas has also drawn up a set of charts, illustrating the varying density of the sea-water of the Bay of Bengal for four seasons of the year.

Weather logs relating to the Bay of Bengal are still received from Commanders of vessels reaching the port, on the plan devised and carried out by Mr. Eliot. One hundred and sixty-one of these have been received during the past year.

INSPECTION OF OBSERVATORIES.—Special arrangements were made during the past cold season for the inspection of a larger number of observatories. Mr. Dallas was deputed to inspect four of those in Rajputana and Central India, two in the Punjab, one in Bombay and one in the Central Provinces. Mr. F. Chambers to the five observatories of Berar, four others in the Central Provinces and one in Bombay. And the Meteorological Reporter to the Government of India inspected three others in the Central Provinces, and subsequently, one in Bengal, five in the North-Western Provinces, four in the Punjab, one in Beluchistan, three in Sind and four in Madras. The Meteorological Reporters for Bengal, the North-Western Provinces and Madras, and the Officiating Reporter for the Punjab have also inspected several of their observatories, and thus by one or another officer of the Meteorological Department, the following observatories reporting to the Imperial Department have been subject to inspection during the year:—

BENGAL AND ASSAM	Dhubri. Bankipore (Patna). Hazaribagh. Darjeeling. Durbhanga. Calcutta (Alipore). Gya.
NORTH-WESTERN PROVINCES AND OUDH	Benares. Allahabad. Agra. Lucknow. Bareilly. Ranikhet. Pithoragarh. Chakrata. Meerut. Jhansi. Dehra.
PUNJAB	Lahore. Mooltan. Peshawar. Rawalpindi. Chamba. Simla. Ludhiana. Delhi. Sirsa. Sialkot. Murree.
CENTRAL PROVINCES	Nagpur. Jubbulpore. Pachmarhi. Hoshangabad. Seoni.
CENTRAL PROVINCES.—*contd.*	Khandwa. Chanda. Raipur.
BERAR	Akola. Buldana. Chikalda. Amraoti. Makhla.
CENTRAL INDIA AND RAJPUTANA	Neemuch. Indore. Mount Abu. Ajmere. Sambhar.
BOMBAY	Kurrachee. Jacobabad. Hyderabad. Rajkot. Surat. Malegaon.
MADRAS	Bangalore. Bellary. Coimbatore. Cuddapah. Madura. Mangalore. Mercara. Negapatam. Salem. Trichinopoly. Wellington.
BELUCHISTAN	Quetta.

About half the observatories have therefore been inspected during the past year.

PART II.—DETAILS OF ADMINISTRATION.

OBSERVATORIES.

At the commencement of the year under report, there were 128 observatories in India and elsewhere, contributing original registers to this office. A new observatory was opened at Tezpore in Assam on the 2nd April 1885, and a voluntary observatory, furnished with instruments from this office, has been established at Baroda and began work on the 26th January 1886. There have also existed observatories at Calicut and Coconada for some years past in connection with the Bombay and Bengal Storm-warning Systems, but the registers have not been communicated to the Central Office. These have now been called for.

On the other hand, the voluntary observatory at St. Fidelis' School, Mussooree, had become so irregular in its working, as to be of little or no value to the department, and the instruments were therefore withdrawn in November 1885, the registers having ceased some months previously. Thus, at the close of the year, there were 131 observatories working in connection with the department. These are enumerated in the following list which also specifies the class to which they belonged at the close of the year. The classes are:—

1st Class, furnished with autographic instruments for pressure, temperature, humidity, rainfall and wind registration, either continuously or at short (10 minutes') intervals.

2nd Class.—Hourly observations recorded on four days in each month; on other days, 3 times during the day. Or observations recorded daily 4 times at intervals of 6 hours. Certain of these observatories are also furnished with anemographs for the continuous registration of the wind.

3rd Class.—Observations of pressure, temperature, &c., recorded twice daily, *viz.*, at 10 A.M. and 4 P.M., and measurement of rainfall at 6 P.M.

4th Class.—Observations of temperature, wind and rainfall only, similarly recorded.

BENGAL AND ASSAM.

	Class.		Class.		Class.
Dhubri	2nd	Darjeeling	3rd	Calcutta (Alipore)	1st
Tezpur	3rd	Purneah	,,	Do. (Chowringhee)	4th
Sibsagar	,,	Durbhanga	,,	Demagiri	,,
Silchar	,,	Gya	,,	Mongpoo	,,
Bankipore (Patna)	,,	Berhampore	,,	Tura	,,
Hazaribagh	,,	Burdwan	,,	Pedong	3rd
Saugor Island	2nd	Jessore	,,		
Cuttack	3rd	Dacca	,,		
Chittagong	,,	False Point	,,		

NORTH-WESTERN PROVINCES AND OUDH.

	Class.		Class.		Class.
Allahabad	1st	Mussooree (Surveyor Genl.'s office)	3rd	Meerut	3rd
Agra	3rd	Dehra (Surveyor Genl.'s office)	,,	Gorakhpur	,,
Lucknow	,,	Do. (Forest School)	4th	Ghazipur	,,
Roorkee	,,	Bareilly	3rd	Benares	,,
Chakrata	,,			Jhansi	,,
Ranikhet	,,			Pithoragarh	,,

PUNJAB.

	Class.		Class.		Class.
Lahore	2nd	Murree	3rd	Kailang	3rd
Mooltan	3rd	Sialkot	,,	Delhi	,,
Dera Ismail Khan	,,	Ludhiana	,,	Sirsa	,,
Peshawar	,,	Chamba	,,		
Rawalpindi	,,	Simla	,,		

CENTRAL PROVINCES.

	Class.		Class.		Class.
Nagpur	2nd	Hoshangabad	3rd	Sironcha	3rd
Jubbulpore	,,	Seoni	,,	Raipur	,,
Pachmarhi	,,	Khandwa	,,	Sambalpur	,,
Saugor	3rd	Chanda	,,		

BERAR.

	Class.		Class.		Class.
Akola	3rd	Chikalda	3rd	Makhla	4th
Buldana	,,	Amraoti	,,		

CENTRAL INDIA AND RAJPUTANA.

	Class.		Class.		Class.
Jeypore	1st	Indore	3rd	Sambhar	3rd
Sutna	3rd	Mount Abu	,,	Bickaneer	,,
Nowgong	,,	Pachpadra	,,		
Neemuch	,,	Ajmere	,,		

BOMBAY.

	Class.		Class.		Class.
Colaba (Bombay)	1st	Jacobabad	3rd	Baroda	3rd
Belgaum	2nd	Hyderabad (Sind)	,,	Surat	,,
Poona	,,	Bhuj	,,	Malegaon	,,
Deesa	,,	Rajkot	,,	Ratnagiri	,,
Kurrachee	,,	Sholapur	,,	Karwar	,,

MADRAS.

	Class.		Class.		Class.
Vizagapatam	2nd	Kurnool	3rd	Madura	3rd
Bellary	,,	Cuddapah	,,	Calicut	,,
Trichinopoly	,,	Madras	,,	Wellington	,,
Gopalpur	3rd	Bangalore	,,	Mercara	,,
Coconada	,,	Negapatam	,,	Mangalore	,,
Masulipatam	,,	Salem	,,	Rajamundry	,,
Secunderabad	,,	Coimbatore	,,	Cochin	,,

BURMA.

	Class.		Class.		Class.
Rangoon	2nd	Akyab	3rd	Toungoo	3rd
Bassein	3rd	Thayetmyo	,,	Moulmein	,,
Diamond Island	,,	Mergui	,,		

BAY ISLANDS.

	Class.		Class.
Port Blair	3rd	Nancowry	3rd

EXTRA INDIAN.

	Class.		Class.		Class.
Leh . . .	2nd	Bushire . . .	3rd	Katmandu . .	3rd
Aden . . .	„	Quetta . . .	„	Amini Divi (Lakhadives) . .	„

During the year the following observatories, formerly of the second class, having contributed hourly observations for at least ten years, were reduced to the third class, excepting that the anemographs have been retained at those stations which possessed them, and the synoptic observations, recorded at Greenwich mean noon, are continued :—

Roorkee	Patna	Sibsagar
Agra	Hazaribagh	Chittagong
Lucknow	Cuttack	

and one, *viz.*, Allahabad, has been raised to the status of a first class observatory.

OBSERVATORIES IN BENGAL AND ASSAM.—*The Alipore Observatory.*—This observatory serves as a general depôt for the verification of instruments, as well as for observations of an experimental character, and an important part of the work is the working of the time signals for the port of Calcutta. It is immediately superintended by the Reporter to the Government of India, and the establishment is under the charge of the Chief Observer, Babu Brojo Mohun Rakhit, B.A. During the past year the work of the observatory has consisted of—

1st.—Continuous registration, by autographic instruments, of (*a*) the duration of bright sunshine, (*b*) the atmospheric pressure, (*c*) temperature, (*d*) moisture (dry and wet bulb thermometers), (*e*) wind direction, movement and pressure, and (*f*) rainfall.

2nd.—Periodical readings, five times daily, of the barometer, dry and wet bulb thermometers, measurements of rain and estimates of cloud proportion, once daily of the maximum and minimum thermometers in shade, those of the exposed thermometers for nocturnal radiation and insolation, and thrice daily those of ground thermometers at the surface, 1 foot, 3 feet, and once at 6 feet deep. Also occasional observations on the movements of the higher clouds by means of the nephescope.

3rd.—The verification of all thermometers issued to observatories throughout India, with the exception of those under the Meteorological Reporter for Western India, and the comparison of all barometers with the Calcutta standard.

4th.—The determination of the mean local time, by meridian observations of the sun, and the working of the time signals for the guidance of the shipping in the port. Also the custody and rating of Government chronometers.

The establishment for the above purposes consists of—

Babu Brojo Mohun Rakhit, B.A., Chief Observer.
„ Annoda Prosad Banerjee, B.A., 1st Photo. Assistant.
„ Ram Chandra Chackravarty, 2nd ditto.
„ Mahendro Nath Banerjee, Observer.
„ Shyam Lall Sen, Observer.
2 Artificers.
1 Batteryman.
6 Servants.

The autographic instruments consist of a sunshine recorder, the Kew barograph and thermograph, which register by photography, a Beckley's anemograph, and Osler's anemometer and a Beckley's rain-gauge. During the past year, with but slight exceptions, the instruments have worked well.

The interruptions of the photographic records though more frequent than is desirable,

owing chiefly to the imperfect working of the instruments, have been of short duration, rarely exceeding one or two hours.

It was mentioned in last year's report, that in March 1884, a bubble of air had penetrated the Torricellian vacuum of the barograph barometer-tube, causing a depression of the column and altering the zero value of the instrument. Since then, the barograph trace measurements at the hours of reading the standard barometer have been compared with the eye readings of the latter instrument month by month, and a correction applied to the former to equalize them to the latter. The results of these comparisons are given in the following table:—

Comparative mean reduced readings of barograph and standard barometer in 1885.

1885.	Standard Barometer.					Barograph.				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
January	30·070	30·144	30·013	30·076	30·076	30·038	30·119	29·986	30·051	30·049
February	29·951	·025	29·901	29·964	29·960	29·923	·002	·876	29·942	29·936
March	·897	29·963	·833	·910	·901	·873	29·943	·811	·892	·880
April	·746	·804	·670	·756	·744	·726	·786	·648	·739	·725
May	·744	·792	·674	·743	·738	·722	·771	·649	·723	·716
June	·552	·588	·491	·578	·552	·521	·558	·456	·549	·521
July	·539	·574	·490	·572	·544	·504	·551	·458	·547	·515
August	·552	·594	·507	·591	·561	·516	·566	·469	·558	·527
September	·726	·778	·678	·760	·736	·698	·760	·648	·736	·711
October	·864	·921	·808	·878	·868	·841	·903	·782	·857	·846
November	·983	30·045	·934	30·006	·992	·963	30·029	·909	·987	·972
December	30·023	·089	·973	·040	30·031	30·004	·074	·952	30·022	30·013
Year	29·804	29·860	29·748	29·823	29·809	29·777	29·839	29·720	29·800	29·784

The constancy of the standard (Newman's No. 109, with a constant correction of —0·005 to assimilate it to the old Calcutta standard,) is verified by series of comparative readings, made at intervals of 6 months, with two other barometers of similar construction; (Newman's No. 86 and No. 112.) If there has been any change in their relative values since July 1883, it is in a slight depression of the two secondary standards or perhaps in No. 109 only, but this is doubtful.

The following table gives a comparison between the eye readings of the compared and corrected thermometers under the thermometer shed at Alipore, with the corresponding thermograph traces, which shows that the relative values of the dry bulbs have remained unaltered. The difference of the wet bulbs has apparently increased by 0·2°, but as the exposure of the instruments is not the same, it may be due to some change in the local conditions affecting the readings.

Comparative mean readings of the thermograph and dry bulb thermometer in the thermometer shed in 1885.

1885.	Thermometer in shed.					Thermograph (dry bulb.)				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	58·7	69·4	76·6	62·7	66·9	59·5	68·1	75·4	63·2	66·6
February	61·0	70·7	77·2	65·1	68·5	62·0	70·2	76·4	65·9	68·6
March	70·9	82·1	88·8	75·5	79·3	72·0	81·4	88·1	76·5	79·5
April	76·8	89·9	97·0	80·9	86·2	78·2	89·6	96·6	82·4	86·7
May	78·1	89·4	91·4	80·4	84·8	79·4	89·9	91·9	81·7	85·7
June	80·6	87·1	88·2	81·6	84·4	81·5	88·0	89·1	82·5	85·3
July	79·4	84·6	85·2	80·8	82·5	80·3	85·3	86·1	82·4	83·5
August	78·9	82·0	82·0	79·7	80·7	79·5	82·4	82·8	80·3	81·3
September	78·8	83·6	84·3	80·5	81·8	79·5	83·9	85·0	81·2	82·4
October	75·7	83·3	84·6	77·1	80·2	76·6	83·0	84·7	78·0	80·6
November	65·9	75·5	79·4	68·8	72·4	66·9	75·0	78·8	69·6	72·6
December	59·0	68·2	73·6	61·9	65·7	59·7	67·2	72·7	62·3	65·5
Year	72·0	80·5	84·1	74·6	77·8	72·9	80·3	84·0	75·5	78·2

Comparative mean readings of the thermograph and wet bulb thermometer in the thermometer shed in 1885.

1885.	Wet bulb in shed.					Thermograph (wet bulb.)				
	6 hours.	10 hours.	16 hours.	22 hours.	Mean.	6 hours.	10 hours.	16 hours.	22 hours.	Mean.
	°	°	°	°	°	°	°	°	°	°
January	57·1	61·6	63·6	60·3	60·7	57·0	61·0	63·3	60·3	60·4
February	59·3	62·3	64·0	61·8	61·9	59·6	62·1	64·1	62·2	62·0
March	69·2	72·1	70·5	71·4	70·8	69·6	72·4	71·9	72·1	71·5
April	73·7	75·6	73·0	75·7	74·5	74·5	76·7	75·1	76·6	75·7
May	75·4	78·1	76·3	75·1	76·2	76·3	79·8	78·4	76·4	77·7
June	78·6	80·2	79·9	78·5	79·3	79·0	81·1	80·8	79·0	80·0
July	78·2	80·2	80·3	79·0	79·4	78·6	80·9	81·2	79·5	80·1
August	77·7	78·9	78·8	78·2	78·4	78·0	79·3	79·5	78·5	78·8
September	77·2	79·0	79·0	78·1	78·3	77·7	79·8	80·2	78·7	79·1
October	74·6	76·5	75·5	75·2	75·5	75·2	77·4	76·6	75·8	76·3
November	64·0	67·6	68·0	66·3	66·5	64·5	67·7	68·4	66·8	66·9
December	57·3	61·8	62·7	59·6	60·4	57·3	61·4	62·9	59·7	60·3
Year	70·2	72·8	72·6	71·6	71·8	70·6	73·3	73·5	72·1	72·4

The sunshine recorder has continued to work satisfactorily. The observations of ground temperature have been carried on as in the previous year. An abstract of the registers is given in the report on the Meteorology of India in the year 1885.

The number of instruments verified at the Alipore Observatory, during the year ending 31st March 1886, is as follows. Excepting aneroids and solar radiation thermometers, rain-gauges and measure-glasses, the number is considerably below that tested in the previous year.

Instruments.	No.
Barometers	42
Aneroids	27
Dry and wet bulb thermometers	8
Maximum thermometers for air temperature	7
Minimum do. do. do.	27
Do. do. for nocturnal radiation	28
Solar radiation thermometers	55
Standard thermometers	5
Six's do.	1
Sling do.	5
Common do.	2
Clinical do.	1
Salinometer	1
Rain-gauges	17
Measure-glasses for rain-gauges	27
Sunshine recorder	1
TOTAL	254

The following is a return of the instruments received and issued by the observatory. The instruments' store is now attached to the Calcutta Meteorological Office.

Instruments.	Received.	Issued.
Barometers	52	32
Aneroids	17	16
Dry and wet bulb thermometers	8	10
Maximum thermometers for air temperature	12	18
Minimum do. do. do.	17	28
Do. do. for nocturnal radiation	27	25
Solar radiation thermometers	44	56
Standard thermometers	0	4
Six's do.	1	1
Common do.	2	2
Clinical do.	1	1
Salinometer	1	1
Sunshine recorder	1	1
Traveller's maximum and minimum thermometers	12	0
Rain-gauges	17	17
TOTAL	212	212

The time signals have worked satisfactorily, though the occasions of failure have been somewhat more numerous than in the previous year. Both balls dropped correctly on 280 days; one failed on four days, the other on two days, making six failures in all,

but as these occurred on different days, one or the other ball gave a correct time signal on 286 days. The remaining days (79) were either Sundays or public holidays.

Table showing the occasions of failure of two time balls during the official year 1885-86.

Dates of failures.	Number of failure.
8th April 1885 . . .	Time ball on the Semaphore tower, Fort William, dropped a few seconds late.
27th April 1885 . . .	Ditto ditto ditto.
29th May 1885 . . .	Ditto ditto ditto.
11th July 1885 . . .	Ditto ditto ditto.
17th October 1885 . .	Time ball at the Port Commissioners' Office failed altogether.
5th February 1886 . .	Ditto ditto ditto.

On a representation from ship masters in the port, of the inconvenience arising from the suspension of the time signal service on Sundays and holidays, and also of the importance of signalling at once to the shipping any inexactitude in the working of the signals, this office has been in correspondence with the Government of Bengal, with a view to making the service continuous, and also of providing means for signalling the occurrence of a failure. The subject is still under the consideration of the Bengal Government.[1]

OTHER OBSERVATORIES IN BENGAL AND ASSAM.—A list of the observatories reporting to the office of the Imperial Government has been given at page 16. Those reporting only to the Provincial Office are enumerated below in a foot-note.[2]

Some extracts from Mr. Pedler's report, on the condition and working of the observatories under his charge, is given in Appendix A. Of the observatories on the Imperial list, ten (exclusive of the two Calcutta observatories) have been inspected during the past year, *viz.*, Darjeeling, Bankipore (Patna), Dhubri, Hazaribagh and Durbhanga, by Mr. Pedler, Gya by myself, and Saugor Island, Purneah, Jessore and Dacca by Mr. Pedler's Head Clerk. That of Dhubri, fomerly an excellent observatory, was found to be in a very unsatisfactory condition, owing to the incompetence of the man, (formerly Assistant observer,) who had been appointed Observer on the death of his predecessor. He has been given notice of dismissal and his place will shortly be supplied by a man trained to his work at Alipore.

The site of the Purneah Observatory has deteriorated in point of exposure, owing to the growth of trees round about it, and it will have to be removed, however much such a step may be regretted on general grounds.

[1] Since the above was written, the proposals have been sanctioned and the service is now uninterrupted.

[2] The observatories established for the system of daily local report in Bengal are the following :—

Balasore.	Furreedpore.	Bhagalpore.	Nya Doomka.
Midnapore.	Mymensingh.	Chupra.	Ranchee.
Raneegunge.	Rampore Bauleah.	Motiharee.	Chybassa.
Noakholly.	Dinagepore.	Buxar.	Bogra.
Burrisal.	Rungpore.	Arrah.	Maldah.
Serajganj.	Bankoora.	Krishnagar.	
Comillah.	Julpigoree.	Dehree.	

The Jessore Observatory was found to be in an unsatisfactory condition, and the special allowance previously granted to the Observer has been suspended in consequence.

The Dacca Observatory was also found to be somewhat defective. That of Gya, which was inspected by myself in December, was, on the whole, better than I had expected, but the Meteorological Reporter to the Government of Bengal has had occasion to censure the Observer on more than one occasion, and it is certain that, from whatever cause, his barometric registers have been open to much doubt.

The False Point Observatory was seriously injured in the cyclone of the 23rd September, the thermometer shed being blown away, and the anemometer blown down. Very valuable observations of the barometer were made during the passage of this storm by Mr. Workman, the Observer. Telegraphic communication with Calcutta was in abeyance up to the 6th January, and during this interval, the storm signal service was deprived of one of its most important reporting stations.

A new observatory of the 3rd class has been established at Tezpur, in Assam. It began to work on the 2nd April 1885, but, as yet, has hardly been up to the required standard.

Respecting other observatories in Bengal and Assam, there is little to remark. They have worked satisfactorily, and in many cases excellently well.

Special allowances have been granted for the present year to the Observers enumerated as follows :—

Names.	Stations.	Amounts. ₹
Makhadaprosad Chowdhurj	Burdwan	10
Mahendra Nath Roy	Berhampore	10
Dandadhar Datta Barua	Sibsagar	10
W. H. Alley	Cuttack	5
Nathu Lall	Hazaribagh	5
Ramesh Chundra Bhadra	Silchar	5
Jogin Chundra Banerji	Durbhanga	5

OBSERVATORIES IN THE N.-W. PROVINCES AND OUDH.—It has already been noticed, in Part I of this report, that the observatory at Allahabad, hitherto ranking as one of the 2nd class, has been raised to the status of a 1st class observatory, and has been removed to the new building specially constructed for it in the Chatham lines, and furnished with a meteorograph which records autographically. Readings of the ordinary instruments are recorded by eye at intervals from 5h. 50m. A.M. up to 10 P.M., but the hourly readings of all instruments, formerly recorded on four days in each month during 25 hours in succession, have been discontinued, as well as those hitherto taken daily at 4 A.M.

As the removal of an observatory always introduces some change in the normal or average temperature, humidity, &c., no two sites being exactly alike in these respects, and as it is a matter of great importance that the registers of any future year shall be rigorously comparable with those of past years, observations have been made simultaneously, twice a day, at the new and old observatories, since the beginning of September 1884, and they will be continued till the expiration of two complete years. In the extracts from his Administration Report, (Appendix B,) Mr. Hill notices the differences, which have thus become apparent, in the effects of the two sites on the instruments, and traces them to their probable causes.

The establishment of the Allahabad Observatory consists of—

Babu Kader Nath Chatterjee, Head Observer.
„ Sashibhusun Banerjee, Second „
„ Jadu Nath Chatterjee, Third „
1 Electrician occasionally and casually.
1 Artificer „ „
1 Printer „ „
and 4 menial servants.

The work of the observatory consists of—

1st.—Registering autographically, at intervals of ten minutes, by means of Van Rysselberghe meteorograph, the readings of the barometer, dry and wet bulb thermometers, direction and distance travelled by the wind, and the amount of the rainfall. The register is engraved on a prepared metallic plate, which is afterwards etched, and from which any required number of copies can be printed off.

2nd.—Periodic readings, five times daily, of the barometer, dry and wet bulb thermometers, &c., &c., and once daily of maximum, minimum air temperature, and radiation thermometers, and thrice daily of the ground thermometers at the surface, 1 foot, 3 feet and 9 feet deep, &c., as at the Alipore Observatory. Also the registering of the duration of bright sunshine, and observations on the movements of the higher clouds with a Marie Davy nephescope.

The meteorograph having been brought into good working order, only at the end of the year, no comparison has yet been made between its registers and the eye readings of the ordinary instruments. The latter will continue to furnish the standard values, and the registers of the autographic instruments corrected to them when necessary.

The new observatory accommodates the Meteorological Reporter's Office as well as the observatory establishment.

The three observatories of Lucknow, Agra and Roorkee have hitherto worked as second class observatories, furnishing, in addition to three daily series of observations, hourly readings of all instruments for 25 consecutive hours, four times in each month As more than ten years of these registers have now been recorded, and these suffice to show the normal diurnal variation of the chief meteorological elements, the hourly registers were discontinued at the end of 1885, and a reduction made in the cost of these observatories. Since the beginning of the present year, they have furnished the same observations as 3rd class stations, with the addition of synoptic observations as a part of the international system in correspondence with the United States Meteorological Department, and which it is intended to continue indefinitely.

In June and July, the observatory at Lucknow was, in part, transferred to a different but neighbouring building, the Tashat Baksh. The change, thus introduced, really however affects only the wind registers, the anemograph having been set up on the roof of the present building. The barometer, in a lower room, is at exactly the same elevation as formerly, and the thermometer shed and instruments have not been moved. The observatory was inspected by Mr. Hill in April 1885, and everything found to be in a satisfactory condition.

Roorkee Observatory has not been visited, but has continued to work well.

The Agra Observatory was visited by myself in December 1885 and found to be

in very good order. The chief instruments were re-verified, the barometer cistern cleaned, &c.

Other observatories in the North-Western Provinces, inspected by myself on this tour, are those of Benares, Meerut and Chakrata, and I also visited that attached to the Office of the Survey of India at Dehra. Mr. Hill has inspected Bareilly, Ranikhet, Pithoragarh and Jhansi, also the Benares Observatory on more than one occasion. At all these the barometers and thermometers were re-verified. The observatories of Benares, Chakrata, Pithoragarh and Ranikhet were found to be in excellent order; the others somewhat less so. The Observers at Jhansi and Gorakhpur have both been fined for carelessness. Special meritorious allowances have been conferred on the following Observers for the ensuing year:—

Names.	Stations.	Amounts.
		₹
Chotay Lall	Lucknow	10
Jewa Nand	Ranikhet	10
Chiranji Lall	Roorkee	10
Mir Altaf Ali	Agra	5
Sher Singh	Pithoragarh	5

OBSERVATORIES IN THE PUNJAB.—The observatories in this Province are the same in number and position as in the previous year, and they are enumerated on page 17. Chamba and Kailang are immediately under the Imperial Office, the remainder, under the Meteorological Reporter to the Punjab Government.

The Lahore Observatory still awaits the arrival of some of the autographic instruments, required for its outfit as an observatory of the 1st class. A self-registering rain-gauge and a Beckley's anemograph have been received, but a tower has yet to be built for the latter, and the former did not reach Lahore until after the close of the year.

Meanwhile, the observatory is carried on as one of the 2nd class, hourly observations being recorded on four days in each month. In addition to the observations made at other observatories of the same class, a register is kept of the ground temperature, from the surface down to 6 feet below it; and also the duration of bright sunshine by means of a sunshine recorder. Up to the end of November 1885, the observatory was under the immediate superintendence of the Meteorological Reporter to the Punjab Government, whose residence was in Lahore. But on the transfer of the Meteorological Reporter's duties to Mr. Dallas, whose head-quarters, as 1st Assistant to the Meteorological Reporter to the Government of India, are at Simla, and who permanently resides there, it became necessary to make another provision for the superintendence of the observatory, and Mr. Oman, who had officiated as Meteorological Reporter from the time of Dr. Lawrie's departure up to Mr. Dallas's assumption of that office, was appointed Superintendent of the Lahore Observatory.

A duplicate set of observations (on the scale of a 3rd class station,) is carried on at the old observatory at the Mayo Hospital, in order to determine the effect of the change of site on the normal readings of the chief instruments.

During his tenure of office as Meteorological Reporter, Mr. Oman visited the observatories of Peshawar, Murree, Rawalpindi, Sialkot, Mooltan, Ludhiana, Delhi, and Sirsa. Mr. Dallas, besides visiting Lahore, inspected the Chamba Observatory, and

during my cold-weather tour, or subsequently, before proceeding to Simla, I inspected Lahore, Mooltan, Peshawar and Rawalpindi, and verified the instruments. The less accessible observatories of Dera Ismail Khan, Kailang and Leh have alone remained unvisited.

The observatories of Lahore, Peshawar, and Murree have been found, on the present as on former occasions of inspection, in excellent condition, and the work carefully and accurately performed. That of Rawalpindi was satisfactory on the occasion of my visit, and that of Mooltan also, there having been a marked improvement in its condition since it had been inspected by Mr. Oman in September 1885; that of Sialkot is stated to be satisfactory on the whole, the instruments clean and well cared for, but some small defects were noticed. The reported conditions of the Delhi and Sirsa observatories seem to afford evidence of much neglect, and that of Ludhiana observatory, though better, is not satisfactory. It is to be regretted that Mr. Oman, instead of seeing that the defects noticed were remedied at once, merely reported them to the Superintendents after his return to Lahore, and requested that the observer might be directed to correct them.

The Chamba Observatory was inspected by Mr. Dallas in November 1885. The barometer and anemometer were found to be out of order, and had to be replaced. The thermometers were in good order, but not securely suspended, and exposed to shaking by the winds. The observer is Dr. Barkhurdar Khan, a medical officer in the employ of the Rajah of Chamba, by whom he is allowed to act in the above capacity. The thermometer shed is provided at the Rajah's expense.

The Kailang Observatory has been carried on with the greatest care and attention by the Superintendent, the Reverend A. W. Heyde. In addition to the usual registers, Mr. Heyde has contributed most valuable information respecting the climate and variations of the snowfall, and has carried out a series of experimental measurements, comparing the thickness of a fall of snow with the quantity of water yielded on melting it, which have resulted in showing—1st, that the thickness of a fall of snow, if measured with due precaution and immediately after its fall, bears a nearly constant relation to the quantity of snow-water which it yields; and, 2nd, that under ordinary circumstances and when the fall is not such as to choke the gauge, the ordinary rain-gauge serves to give a very trustworthy measurement of the fall.

A list of the Superintendents and Observers is given in Appendix C.

Special meritorious allowances have been awarded to the following Observers for the ensuing year:—

Names.	Stations.	Amount. R
Jaspat Rai	Lahore	10
Devan Chand	,,	5
Kashi Ram	Peshawar	5
W. Cruikshank	Murree	5
Sergeant J. J. Konig	Simla	5

OBSERVATORIES IN THE CENTRAL PROVINCES.—These are the same as in previous years, and are enumerated at page 17.

Except those at the less accessible stations of Saugor, Sambalpur and Sironcha, all the observatories have been inspected during the year, five of them by the Sanitary Commissioner as well as by officers of the Meteorological Department. Khandwa was

inspected by Mr. Dallas; Nagpur, Raipur, Seoni and Chanda, under instructions from my office, by Mr. Chambers; and Hoshangabad, Pachmarhi and Jubbulpore by myself in November last.

The Nagpur Observatory was found to be in excellent order as regards all the ordinary instruments, and the observer P. Soobiah read all the instruments accurately. But the large anemograph was found to be working very stiffly for want of cleaning. This was effected before Mr. Chambers's departure. The sunshine recorder supplied to Nagpur had not been set up at the time of Mr. Chambers's inspection.

Jubbulpore and Pachmarhi, the other two observatories of the 2nd class, were inspected by myself. The Jubbulpore observatory was generally in good condition. The sun thermometer, being however defective in action, was withdrawn. The wind-vane had become worn and worked stiffly, and owing to the greasiness of the thread, the hygrometer wet bulb had gone dry.

At Pachmarhi things were less satisfactory. The observer appeared to neglect his duty, and to pay but little attention to the official instructions. The ordinary instruments, with the exception of the sun thermometer, were in fair condition, but the large anemograph was in a state similar to that of Nagpur, having never been cleaned since it was put up. The instrument was taken to pieces during my visit and put into the hands of the regimental armourer for the purpose.

At Seoni, the anemometer wanted cleaning, and a minimum thermometer was not in workable condition, but this last does not imply any neglect on the part of the observer, who is an intelligent, painstaking man, but one who has never had any regular training at a standard observatory.

At Raipur, which had not previously been visited by any officer of the Department, several small matters required remedying; but, in general, the instruments appeared well cared for, and the observer read them accurately.

With the exception of the anemometer and wind-vane, which required cleaning, the state of the Chanda Observatory and the work of the observer were equally satisfactory.

The Khandwa Observatory, which was inspected by Mr. Dallas in January 1886, was found to be in good order; the instruments clean and well exposed. With the exception, that the wind-vane required oiling, the anemometer was rather sheltered by a tree, and that the sun thermometer had been somewhat injured in transport; there was little or nothing requiring to be remedied.

The Hoshangabad Observatory was inspected by myself in November 1885. The wind-vane and anemometer are screened by a large tree to the north-west. The barometer, thermometers and all other instruments were found to be in good condition, but the observer does not always read them correctly.

Special allowances have been awarded to the following Observers in the Central Provinces for the ensuing year:—

Names.	Observatory.	Amount. R
Seetaram	Chanda	5
Pancham	Seoni	5
P. Soobiah	Nagpur	5
Behary Lall Parasar	Khandwa	5
Jadunath Basu	Saugor	5

OBSERVATORIES IN BERAR.—These are the same as in former years—five in number—of which one, at Makhla, is a 4th class observatory, established and carried on by the Forest Department.

All these were visited and inspected by Mr. F. Chambers in 1886. At Amraoti, the thermometer shed was found to be well placed, but the anemometer was on a post only 6 feet high, surrounded by trees and buildings. The barometer was very dirty, as also were certain other instruments, but the observer, though apparently careless, knew how to read his instruments correctly.

At Akola, everything was found in excellent condition as far as depended on the observer. But the barometer and sun thermometer had somewhat deteriorated owing to natural causes, and the observer, although careful and conscientious in his work, appears not to be thoroughly acquainted with the proper mode of performing it.

The Buldana Observatory was removed to a new site at the civil hospital in 1885, and comparative observations are now made at both the old and new sites to determine the difference of their conditions. The barometer had become somewhat dim, but was still in serviceable condition. The thermometers and most of the instruments were in good order, and the observer knew how to read his instruments correctly.

At Chikalda, the wind-vane and anemometer were found to be in a bad position, and the sun-dial was not correctly set in azimuth. Except that the barometer cistern had become somewhat dim, the instruments generally were in excellent condition, and the observer is reported to be intelligent and to read his instruments accurately.

Makhla is an observatory in the forest, surrounded by trees, and the wind observations are of little value on this account. The hygrometer was found to be too much enclosed to show the true humidity of the air, but in general the arrangements were fairly satisfactory, and the observer intelligent.

A nominal list of Superintendents and Observers at the Berar stations is given in Appendix C. The following Observers have been re-allotted special allowances during the current year :—

Names.	Observatory.	Amount. ₹
Samuel Gregory	Akola	10
Hera Lall	Chikalda	5
Bukaram Pandurang	Amraoti	5

OBSERVATORIES IN CENTRAL INDIA AND RAJPUTANA.—These are the same as in previous years, and are enumerated on page 17. The Maharaja's observatory at Jeypore, which is a 1st class observatory, sends its registers to the Reporter for the North-Western Provinces and Oudh.

Of the remaining observatories, those of Nowgong, Sutna, Ajmere and Sambhar are under the Meteorological Reporter for the North-Western Provinces and Oudh. Those of Neemuch, Indore, Mount Abu and Bickaneer, report to the Meteorological Reporter for Western India, and that of Pachpadra, sends its registers direct to the Central Office.

The observatories of Jeypore, Sambhar, Ajmere, Mount Abu, Neemuch and Indore were visited and the Government observatories inspected by Mr. Dallas, 1st Assistant Meteorological Reporter to the Government of India, in December and January.

The Sambhar Observatory was in a somewhat neglected condition; the thermometers dirty and in some cases not acting properly, and the shed in bad repair. The observer's practice was also in some respects erroneous. The barometer was, however, in good condition and properly suspended.

Ajmere Observatory has become much deteriorated in point of exposure, owing to the growth of shrubs and trees round about it, the observatory being situated in the public garden. The thermometers were dirty and the graduations almost obliterated. The anemometer and wind-vane were in good order and the latter correctly set. It has become necessary to remove the observatory to a more open site, and with the permission of the Principal, Major Loch, it will be moved to the Mayo College.

Mount Abu was found to be in good order, and the observer is reported to take great interest in his work. The thermometer shed was rather small, and one or two instruments were old, but otherwise there was little calling for remark.

The Neemuch Observatory was also in very satisfactory condition as far as depended on the observer. The arrangements for recording the wind involved some inconvenience and probable inaccuracy, and these have been since improved.

The Indore Observatory was less satisfactory, the barometer being very dirty and scarcely readable. The thermometer shed and fences were, however, in good order, but the exposure has been somewhat injured by low buildings and large heaps of building materials round three sides of it. Its position too is said to be objectionable, being too much in a hollow to be fairly representative of the climatological conditions of the country around. The wind arrangements are reported as unsatisfactory, which is also the case at many other stations in Western India, where, on principle, a piece of rag has been made to do duty for a vane. The resulting practice is frequently of the most primitive character and involves much guessing.

The observatories at Sutna, Nowgong, Pachpadra and Bickaneer have not been inspected. The first is, however, known to be excellently conducted, and the second is believed to be excellently supervised. The other two are probably in want of inspection, and this will be effected as soon as they are more accessible than at present.

Special allowances have been granted or renewed to the following Observers in Rajputana and Central India:—

Names.	Stations.	Amount. Rs
Harnath	Sutna	10
Rampershad	Ajmere	5
Trimbak Rao	Indore	5

OBSERVATORIES IN BOMBAY.—These, excepting the Colaba Observatory, are all under the Meterological Reporter for Western India.

Of the four 2nd class observatories, Kurrachee was inspected by myself in January, the others have not been visited during the year. Of the 3rd class observatories the Reporter for Western India visited those of Surat, Rajkot, Malegaon and the voluntary observatory at Baroda, and I inspected those of Jacobabad and Hyderabad.

The Kurrachee Observatory was found to be in admirable condition, everything being clean and in good repair, and the work of observation appeared to be equally satisfactory.

The Surat Observatory is stated to be in a good position for registering the temperature, but too much surrounded by large trees to afford good indications of the wind. The instruments were in good order, except that the barometer had become somewhat be dimmed in the course of years. The observer read all the instruments accurately.

The Baroda Observatory has only recently begun to contribute registers, and little can be said of its work.

Rajkot was inspected in November last. It has not been a satisfactory observatory for some time past, which is explained by the fact that the man appointed as observer got into debt, and eventually ran away to escape from his creditors. His successor is said to have had but little training, and his work was far from satisfactory. He was dismissed at the end of the year under report. It appears from Mr. Chambers's report that the observatory stood in much need of inspection.

The observer at Malegaon is said to be painstaking but inexperienced, and in several respects his practice was faulty, and the instruments improperly dealt with. The majority of the instruments were, however, in good order.

The Jacobabad Observatory was found to be in very good order, and the registers apparently accurate and neatly kept.

At Hyderabad the observatory was removed in June 1885 from the European military hospital to the jail—a site offering in some respects a much better exposure. A new observer took over the duties in January, a short time before the observatory was inspected, and though intelligent and painstaking, he had been but imperfectly trained. Some of the instruments, especially the hygrometers and the anemometer, were not in good order, and the barometer was suspended in a bad light.

Of the remaining observatories in Bombay little is said in Mr. Chambers's report. The Beckley's anemographs at Belgaum and Deesa are said to have worked well throughout the year, and the Casella's anemograph at Poona has been in nearly continuous action, but that at Ratnagiri has been less satisfactory. The work of the majority of the observers has been trustworthy, but Hyderabad (under the former observer), Rajkot and Malegaon are exceptions to this rule.

The following special allowances have been awarded for the present year to Observers in the Bombay Presidency :—

Names.	Observatory.	Amount. R
Mahadev Cuddum	Ratnagiri	10
Ramkrishna K. Karandikar	Deesa	5
Narayen Sakaram	Poona	5
G. W. M. D'Aranjo	Karwar	5
Ramchundra Datta	Belgaum	5
Mingue Fernandez	Kurrachee	5
Shaik Ali	Jacobabad	5

OBSERVATORIES IN MADRAS, MYSORE AND HYDERABAD.—Of the 21 observatories in these provinces enumerated in the list on page 17, all but five, *viz.*, the Madras Observatory and those of Gopalpore, Vizagapatam, Coconada and Calicut, are under the control of Miss Pogson as Meteorological Reporter to the Government of Madras. Twelve of the sixteen have been inspected during the year, *viz.*, eight by Miss Pogson and four by myself.

Bellary, a 2nd class station, was visited by Miss Pogson in October 1885. The observatory had been moved to a new site on the 24th April, and the thermometer shed

was therefore nearly new. The instruments were generally in good condition, except that the mercury in the barometer had become slightly oxidized, and all were clean and properly set up. The work is stated to be accurately and carefully performed, but is somewhat tardily sent in.

Trichinopoly, also a 2nd class station, was inspected by Miss Pogson in March 1886. The condition of the observatory was found to be highly satisfactory and most creditable to the Superintendent and Observer. The wind records are temporarily interrupted during the renewal of the staging for the anemometer.

Bangalore was inspected by myself in February 1886, and the chief instruments verified. Everything was found to be in excellent condition, but the barometer had rather a large error, over and above that originally determined. The observer read his instruments correctly, and the registers were neatly kept and brought up to date. As it is probable that the removal of the observatory will soon be absolutely necessary, a site close by was selected, which will involve the least possible disturbance of the existing local conditions.

Coimbatore was inspected by Miss Pogson in August 1885. In June this had been reduced to the same scale as the 3rd class observatories in Northern India, &c., the work and remuneration of the observer both being reduced on the appointment of a new man as observer. The thermometer shed was found to require repair, and the anemometer post and ladder required renewal; in general the instruments were in a satisfactory condition, but the barometer cistern required cleaning, and the wet-bulb thermometer was slightly encrusted. The work of the observer is well reported of.

Cuddapah was inspected by myself in March 1886, and had also been visited by Miss Pogson in October 1885. The instruments were carefully kept, but on verification, the barometer error was found to be larger than that previously determined, and the maximum thermometer had ceased to be self-registering. The sun thermometer also had a portion of the column separated which had not been allowed for. There is no anemometer, and the wind observations are of doubtful value. Also the observer was disregarding the instructions to take his observations according to local time. A staging for the anemometer and wind-vane is now being provided.

The Kurnool Observatory was removed to a better position in the compound of the Collectorate in July 1885, and one of the Collector's clerks appointed observer.

Madura, like Coimbatore, has been reduced to the status of an ordinary 3rd class station, a new observer being appointed after a previous training at Madras. Miss Pogson inspected the observatory in March 1886, and found it and the instruments in a most disgraceful condition of dirt and neglect. The observer seemed to have profited but little by his training, and was performing his work in a most negligent manner.

Mangalore was visited by myself in February 1886, this being the first time that it has been inspected since its establishment. The barometer and thermometers were re-verified, and the former found to have a large unsuspected error. The instruments were well cared for, but the anemometer and wind-vane were not in a good position, and much obstructed, and the thermometer for nocturnal radiation was not in working order.

Masulipatam has been very unsatisfactory, owing apparently to the apathy and negligence of the observer, who had nevertheless been trained at Madras. It has not been inspected, but the registers are full of self-evident inaccuracies, and in other respects the observer has failed to follow the official instructions.

Mercara was visited by myself in February, and the instruments re-verified. Here also a considerable further correction was required to the barometer. The instruments were in creditable condition in general, but the exposure of the wind-vane and anemometer is bad, and the latter was very dirty. The rain-gauge had no internal receiver. The observatory is in course of removal to a site at the dispensary, offering many advantages over the present site at the Electric Telegraph Office.

Negapatam was inspected by Miss Pogson in March 1886, and found to be in very good condition, except that some of the thermometers were improperly suspended. The work of the observer is also well spoken of.

Salem was inspected, also by Miss Pogson, in August 1885. She reports that the general condition of the observatory reflects great credit upon the Superintendent and Observer.

And finally Wellington was inspected in the same month, and everything found to be in good condition, except that the barometer was suspended in a badly-lighted room, used also for other purposes, not quite compatible with the safety of the instrument.

The remaining observatories have not been inspected during the year, but are considered to be working satisfactorily.

A special allowance has been granted to :—

Name.	Observatory.	Amount. R
C. S. Saminatha Pillai	Coimbatore	5

OBSERVATORIES IN BURMA.—As in the previous year, these are eight in number, including Akyab, which is under the administration of the Meteorological Reporter for Bengal, and Diamond Island, which is under the Central Office. The remainder are under the Sanitary Commissioner for Burma.

The six observatories have all been inspected by the Sanitary Commissioner. Some of them twice or oftener, but not by any officer of the Meteorological Department during the past year. The Rangoon Observatory, which, as a 2nd class observatory, ought to set an example to the province, is the subject of the single disparaging remark in the report, and this observatory has never been equal to most of those of its class. There has been an appreciable improvement in several of the 3rd class observatories, more especially Bassein, Toungoo and Thyetmyo, and special allowances for the present year have been awarded to the following Observers :—

Names.	Observatory.	Amounts. R
T. H. Hilbert	Moulmein	5
Maung Pe	Bassein	5
Shaik Hydiat Ally	Toungoo	5

Mr. Pedler reports a considerable improvement in the Akyab registers, which have been punctually submitted.

OBSERVATORIES AT THE BAY ISLANDS.—These observatories have worked satisfactorily, but no special report has been received on their working and condition. Mr. Peters, who has long acted as Observer at Port Blair, in a most satisfactory manner, left in November last, and has been succeeded by Mr. Carroll. There has been a succession of Observers at Nancowry—a state of things by no means conducive to the satisfactory performance of the work, but apparently unavoidable at this unhealthy station. They are enumerated in Appendix C.

EXTRA INDIAN OBSERVATORIES.—There are now but six of these, since the observatories of the Seychelles and Zanzibar ceased to contribute registers. Another, Aden, has now become somewhat irregular, and several months have elapsed since any register was received. The Leh Observatory has been in admirable working order up to October last, when the Actinometric Observer Sergeant Rowland and his Assistant quitted Leh. Since that time, it appears, difficulties have arisen, and it has recently been reported that, if the work is to be carried on satisfactorily, it will be necessary to send a trained man to Leh as observer. There is, and always must be, great difficulty in keeping an observatory in good working order, on the present system of small allowances, unless the position is one readily accessible to inspection.

The Observatory at Bushire has on the whole worked fairly, but recently some of the observations have been less trustworthy.

The work of the Katmandu Observatory has been resumed in full.

The Observatory at Quetta was inspected, for the first time since its establishment, by myself in January last. It was found to be in admirable order, and the observer, an intelligent and painstaking native of Madras, was performing his work in a manner which left nothing to be desired. This satisfactory state of things is entirely due to the careful supervision of Dr. Fullerton, the Residency Surgeon, who has long been in charge of the observatory.

The Amini Divi Observatory was re-established in May, when the Medical Officer, who is also observer, returned to the station. Since that time the registers have been regularly sent in. It is as yet premature to pronounce on the character of the work.

INSTRUMENTS.

In Appendix D is given a return of the instruments in store at the beginning of the year, and of those received and issued by the Calcutta Meteorological Office, and includes the stock, receipts, and issues of the Alipore Observatory; and in Appendix E is a return of the instruments issued to each observatory. In this are incorporated the returns furnished by the local Reporters.

METEOROLOGICAL OFFICERS AND OFFICE WORK.

The general administration of the meteorological observatories and offices in the different provinces, with the local exceptions noticed in the foregoing sections, has been in the hands of the following officers during the year:—

Name.	Office.	Province.
H. F. Blanford, F.R.S.	Meteorological Reporter to the Government of India	Central Office.
W. L. Dallas, Esq.	Assistant Meteorological Reporter to the Government of India	
Lala Ruchi Ram Sahni, M.A.	2nd Assistant Meteorological Reporter to the Government of India	
A. Pedler, Esq. (Offg.)	Meteorological Reporter to the Government of Bengal.	Bengal and Assam.
S. A. Hill, B. Sc.	Meteorological Reporter to the Government of the North-Western Provinces and Oudh.	N.-W. Provinces, Oudh, Rajputana, and Central India (part.)
Dr. E. Lawrie	Meteorological Reporter to the Government of the Punjab.	Punjab.
J. C. Oman, Esq.		
W. L. Dallas, Esq.		

Name.	Office.	Province.
F. Chambers, Esq. . .	Meteorological Reporter for Western India . .	Bombay, Berar, Rajputana and Central India, (part.)
Miss Isis Pogson . . .	Meteorological Reporter to the Government of Madras.	Madras, Mysore, Coorg, and Hyderabad.
Dr. J. H. Loch . . .	Sanitary Commissioner, Central Provinces . .	Central Provinces.
Dr. C. Little . . .	Sanitary Commissioner, Berar	Berar.
Dr. D. Sinclair . . .	Sanitary Commissioner, Burma	Burma.
Surgeon-Major W. N. Keefer	Senior Medical Officer, Bay Settlements . .	Andamans and Nicobars.

With the exception of the Punjab and also of Bengal, where, during Mr. J. Eliot's absence on furlough, Mr. A. Pedler has continued to officiate as Meteorological Reporter, the local Reporter's duties have all been performed by the permanent incumbents of the several offices.

In the Punjab, Dr. Lawrie resigned the office of Meteorological Reporter to the Punjab Government on quitting the province in April 1885. After his departure, the office was temporarily held by Mr. Oman of the Punjab Educational Department, who remained in charge until the 1st December. On that date he was relieved by Mr. W. L. Dallas, 1st Assistant to the Meteorological Reporter to the Government of India, who undertook the duties in addition to those of his previous office (a part of which, however, had been meanwhile transferred to the 2nd Assistant Lala Ruchi Ram Sahni.)

Mr. Dallas was absent on privilege leave from the 31st March to the 28th June 1885.

The 2nd Assistant Lalla Ruchi Ram Sahni, M.A., was appointed to that office on the 1st June 1885, after a probationary course in the department. He has since continued to prepare the daily weather reports and the daily weather charts, and during Mr. Dallas's absence from Simla, when inspecting observatories in the cold weather, he was left in independent charge of the Simla office.

The following table shows the number of stations, the registers of which were sent to each of the Reporters, respectively, for reduction and verification during the year under report :—

Provinces.	Meteorological Reporters.						Total.
	India.	Bengal.	North-Western Provinces and Oudh.	Punjab.	Western India.	Madras.	
Bengal and Assam	4	20	...	...	...	...	24
North-Western Provinces and Oudh .	1	...	14	...	...	...	15
Punjab	2	...	...	11	...	...	13
Rajputana and Central India . .	1	...	4	...	4	...	9
Central Provinces	11	...	...	...	...	...	11
Berar	1	...	...	...	4	...	5
Bombay	...	...	...	...	13	...	13
Madras, Mysore and Coorg . .	1	1	...	...	...	16	18
Burma	7	1	...	...	...	...	8
Bay Islands	2	...	...	...	...	...	2
Extra Indian	5	...	...	...	...	1	6
Total .	33	22	18	11	21	17	124

This list does not include the registers of the provincial observatories in Bengal, nor those of Colaba Observatory, Madras, Goa and of Jeypore, which are furnished to the Meteorological Office with all the necessary reductions.

In Bengal, the North-Western Provinces and Bombay (in part) the Reporters superintend the rainfall registers of the district and sub-divisional stations of their respective provinces and prepare weekly and monthly returns of the rainfall.

In Bengal the number of rainfall stations has been increased by 72 during the past year. New rules for registering the rainfall have been drawn up and translated into the native languages, and statistics have been collected respecting the kind of gauges in use at sub-divisional stations, their position, &c., and the proximity of objects likely to interfere with the accuracy of the record. By this means certain cases have been brought to light, in which the exposure of the instrument was decidedly faulty, and these have been remedied.

The number of rainfall stations dealt with by each of the above officers is as follow:—

	Stations.
Bengal	244
North-Western Provinces and Oudh	253
Bombay	477

In the Punjab, the superintendence and collection of rainfall registers are not at present in the hands of the Meteorological Reporter, but Mr. Dallas reports that the subject is under the consideration of the local Government.

In Madras also, it has been proposed to transfer the charge of the rainfall registration to the Meteorological Reporter for the province, but this has not yet been carried out.

The Reporters for Bengal and Western India administer a system of storm warnings for the protection of the local ports. In the case of the former, this duty has hitherto been restricted to the port of Calcutta, signals being exhibited at certain stations on the Hooghly estuary, more especially for warning vessels about to put to sea. Lately, as has been already noticed in Part I of this report, the system has been extended so as to comprehend all the principal ports of the Bay of Bengal.

The meteorological observations copied from the log-books of ships entering the port of Calcutta are now received and tabulated in the Central Office, Calcutta.

Mr. Dallas having been relieved of the work of preparing the daily weather report and chart, now discharges the duties of the Meteorological Reporter for the Punjab. He has continued the reduction and preparation for publication of the marine observations relating to the North Indian Ocean and the Bay of Bengal, received in 1877 and 1880 from the London Meteorological Office. The barometric wind and current charts, with a descriptive text, are now being printed, and will be shortly issued; and considerable progress has been made with the corresponding series for the Arabian Sea.

OFFICE ESTABLISHMENTS.—The following is a return of the numbers of ministerial officers and menials in the offices of the several Meteorological Reporters:—

	India.		Bengal.	North-Western Provinces.	Punjab.	Western India.	Madras.	Total.
	Calcutta.	Simla.						
Head Clerks	1	...	1	1	1	1	1	6
Computers	3	...	...	...	...	...	...	3
Clerks and copyists	5	...	2	1	3	...	4	15
Tabulators	14[1]	6	9	4	...	8	...	41
Draughtsmen	2[2]	1	1	...	...	...	...	4
Artisans	...	...	3	...	...	...	...	3
Peons and menials	7	5	5	2	2	2	2	25

In December last, Government sanctioned a scheme, submitted in the early part of the year under report, for improving the pecuniary prospects of certain of the ministerial officers, and for placing them on a more equal footing; and also for strengthening the Central Office and those of the Punjab, Western India and Madras Reporters. The net increase of expenditure, thus incurred, amounted to ₹4,000 per annum, and a further sum of ₹5,963 was provided by savings on the salary of the Punjab Reportership (after providing for the salary of the 2nd Assistant above mentioned) and also on the travelling expenses and special Simla allowances previously incurred for the portion of the Central Office previously transferred annually to Simla and back again.

Babu Fanindra Mohun Basu has continued in charge of the Central Office in Calcutta with the same excellent results as in previous years, and I have had much satisfaction in obtaining for him the increase to his salary included in the above scheme. The Head Computer, Babu Nirduksha Kumar Ghosh, has also worked with great intelligence and zeal, and well merits the increase of his salary, which, in common with the other computers, he has recently obtained.

Mr. Pedler (Bengal) reports that his office has worked exceedingly well under the able superintendence of Babu Chandi Charan Chatterjee, and Mr. Hill (North-Western Provinces and Oudh) reports generally that the clerks and tabulators have all worked steadily and well during the year, under the Head Clerk Babu Chintamony Ghosh. Of the establishment of the Madras Office, Miss Pogson reports that each assistant has worked accurately and diligently throughout the year.

WEATHER BULLETINS AND STORM-SIGNAL SERVICE.—Since the 8th April 1885, the daily weather reports issued under the authority of the Department of Revenue and Agriculture, have been drawn up at Simla, a permanent establishment being retained there for the purpose. The reports are issued in the same form as in the previous year. The verbal summary, which accompanies each issue, is telegraphed to all the Provincial Governments, and copies are furnished to the daily newspapers at Calcutta, Allahabad and Bombay,

[1] Besides these, there are three temporary clerks for reducing the London Meteorological Office marine logs.
[2] Besides these, there is one temporary draughtsman for drawing up the marine charts.

295 copies of the printed report are issued daily to Government officers and one to a subscriber.

As a part of the work connected with the daily reports, notice is sent by urgent telegram to the Meteorological Office, Bombay, of the progress of any storms that advance from the Bay of Bengal towards the Western Presidency; and notice by urgent telegram is sent to the Civil and Political Officers of Khandesh and Guzerat of the appearance of storms likely to produce floods in the Tapti and Nerbuda; arrangements have been made also for telegraphing direct to the same officers, from certain observatories in the upper drainage basins of these rivers, the occurrence of heavy rain, in order to give them due warning of probable floods.

In Bengal, the Daily Weather Report for the province was issued from the 20th April to the 7th November, and the Bay of Bengal Weather Report illustrated by a chart, throughout the year. The latter was issued to 39 Government officers and 22 subscribers, the former to 99 Government officers and 19 subscribers.

The storm signals were hoisted on three occasions during the year, *viz.*, for the False Point cyclone of the 22nd September, for a storm which reached the Sunderbuns on the 14th and 15th October, and for that of the 14th to the 23rd November. This storm was formed off the coast of Ceylon and tracked, day by day, in the Bengal Weather charts, as it moved up the Bay, finally crossing the Arakan coast south of Chittagong and breaking up among the Arakan hills. There has been no previous instance of a storm being followed up the Bay with such precision, and indeed it is a rare case that any storm follows so long a course, at so leisurely a rate of progress, and in such a direction (north-east) as this.

At stations on the Bombay coast, the signals were hoisted only on one occasion during the year, *viz.*, for the little storm of the 8th to 10th June, which appears to have originated in the south of the Peninsula, and not as has usually been the case, on the Bay of Bengal. It was very small and the barometric disturbance slight.

WEEKLY, MONTHLY AND SEMI-ANNUAL REPORTS.—From May to October, a descriptive summary of the weather is prepared monthly; during the rest of the year every alternate month; and published in the *Gazette*. Reports on the winter and spring snow-fall were also drawn up in May and June, and a forecast of the character of the rains was attempted, which has been noticed at length in Part I of this report.

Charts of the rainfall for the three seasons, into which the year has been divided for this purpose (the cold season, the hot season, and the rains) have been prepared for 1885 from the rainfall registers received by post, and several copies furnished to Government, but these are not published. A general chart and tabular return of the rainfall of the year was also prepared for the Secretary of State.

In Bengal, weekly and monthly Meteorological and Rainfall Reports, for the province, are published in the *Calcutta Gazette*, and sets of 3 rainfall charts, showing the actual distribution of the rainfall and its variation from the average 1st, in absolute measurement and 2nd as a percentage of the normal average, are prepared monthly for Government. A general summary of the weather of the monsoon and the distribution of the rains, in Bengal, was also drawn up for the Government of Bengal.

In the North-Western Provinces and Bombay, monthly abstracts of the registers of the several observatories are published in the local *Gazettes*, and in the Punjab, since the

beginning of 1886, a descriptive summary of the weather of the province has been prepared for Government and published in like manner.

ANNUAL REPORTS.—The report on the meteorology of the year 1884 was complete and in the printer's hands by the beginning of December 1885, and the printed report submitted to Government on the 23rd March 1886.

The report gives tables of temperature for 138 stations, and rainfall returns for 478 stations, being an increase of four of the former and sixteen of the latter on the numbers respectively given in the report for 1883. The returns of most other meteorological elements are nearly as numerous as those of temperature. The elements tabulated in the Appendix are as follow. For comparison I give the corresponding number for the four previous years :—

	Number of stations.				
	1880.	1881.	1882.	1883.	1884.
Equilibrium temperature of solar radiation	109	106	112	111	113
Duration of bright sunshine	...	...	...	2	3
Temperatures of nocturnal radiation	108	106	104	107	106
Temperatures of the ground	2	4	4	4	4
Mean and extreme air temperatures	126	131	130	134	138
Sea-level equivalents of mean temperatures	105	108	108	111	112
Means and extremes of atmospheric pressure	122	251	124	125	127
Sea-level equivalents of mean atmospheric pressure	105	107	108	109	110
Direction and movement of winds	124	127	125	127	128
Temperature of evaporation	115	121	120	124	128
Tension of atmospheric vapour	123	128	127	130	135
Mean relative humidity	123	128	127	130	135
Mean proportion of clouded sky	122	125	124	127	130
Inches of rainfall in each month	399	417	457	462	478
Number of days on which rainfall was measured	379	403	457	462	474

The descriptive letter-press discusses the chief characteristics of the meteorology of the year. It includes tables of the average values of all the more important meteorological elements, for all stations that have furnished returns for three years and upwards, and the report is illustrated with four plates, *viz.*, a chart showing the position of all observatories and rain-gauge stations, and three in coloured lithography, representing the mean distribution of temperature, pressure, and winds in each month of the year.

The original observations of six observatories, *viz.*, Calcutta, Lucknow, Lahore, Nagpur, Bombay and Madras, were issued in a distinct publication in monthly parts. Those forming the volume for 1885 were completed in June 1886.

The Reporters for Bengal, the North-Western Provinces, the Punjab, and Bombay, each prepared and submitted to the local Governments, summaries of the weather features of the year 1884 in their respective provinces.

MISCELLANEOUS PUBLICATIONS.—Parts IV and V of Volume II of the Indian Meteorological Memoirs were issued during the year, completing the second volume of the work. The first, already referred to in last year's report, contains a very important and elaborate discussion of the characters and tracks of all the storms of the Bay of Bengal, that have been recorded on the office charts, during the months May to December, in the five years 1877 to 1881. The second contains a short Memoir of Mr. Hill's on the variations of the temperature and humidity of the atmosphere at 4 and 40 feet above the ground surface at Alipore. Also the title page, lists of contents and general index to the volume.

Part I of Volume III was issued just before the close of the year, containing the first part of a Memoir on the rainfall of India, which, when complete, with its tables, will occupy the whole volume. Three other Memoirs, *viz.*, one by Mr. Eliot on the Akyab cyclone of the 12th to 17th May 1884, one by myself on the diurnal variation of the rainfall of Calcutta, and one by Mr. Dallas on the meteorology of a sea tract to the south of the Bay of Bengal, were printed and nearly ready for issue at the close of the year, forming Part I of Volume IV.

Other Memoirs are in course of preparation by Mr. Hill, Mr. Pedler and myself. Mr. Chambers, on the plea of want of sufficient office assistance, has contributed nothing to the official publications of the department since the list of storms drawn up in 1882, and published in Part I, Volume II of the Memoirs.

Appendix F, gives a list of the Government officials, libraries, observatories, societies, &c., to which the publications of the office are presented, including those which send their own publications in exchange.

LIBRARY.

The additions to the library during the past year are enumerated in Appendix G, under 215 titles. The library remains, as last year, in ten double book-cases in a large room on the ground floor of the office building. It is in good order, but it has not been practicable to undertake its re-arrangement, no officer having been available for the purpose.

HENRY F. BLANFORD,

Meteorological Reporter to the Government of India.

SIMLA:

The 28th July 1886.

APPENDIX A.

Extract from the Administration Report of the Meteorological Reporter to the Government of Bengal.

* * * * * * *

"Both the second class observatories were visited during the year. *Dhubri* was inspected by myself on 19th March 1886. Generally speaking, I was far from satisfied with the condition of the observatory. The Casella's anemograph was, so far as [regards] direction, working with considerable friction, and the pointer was showing south-south-west, but in reality the wind was east-north-east. It showed a great want of observation on the part of the observer to record and report a wind direction almost diametrically opposite to the actual direction. The thermometers were dirty and covered with cobwebs. The bulbs of the wet instruments were found to be slightly encrusted, and the compound of the observatory was considerably overgrown with jungle. The solar radiation thermometer had a separation of mercury at the top of the tube of almost exactly 4°. The observer stated that he made allowance for the break, and that he had reported the fact to the head office, but the statement could not be verified from the office records either at the observatory or at the head office. The rain-gauge receiver was found to hold only 1·38 inches of rain, and the observer stated that if the reservoir overflowed, he mopped up the excess water with a cloth and squeezed out the water into the measuring glass. The rain-gauge was therefore changed for a 5-inch gauge with a proper receiver. The anemometer was in very bad order with the cups dented, and the instrument was erected in a most disgraceful manner. A new anemometer has been supplied. The observer and his assistant do not appear to understand their work properly. The observer's knowledge of English is very limited, and he is not in my opinion competent for the post of senior observer, though he might perhaps have previously done his work as assistant overseer properly. A new head observer will have to be appointed after a man is thoroughly trained in the Alipore Observatory. By my visit to the station, my former convictions of the carelessness of the observer were fully confirmed. In July 1885, I had occasion to fine the head observer Kadimuddin Ahmed ₹5, and his assistant his allowance for nine days, for neglect of duty in missing the hourly observations on several days, but the fines scarcely seem to have had the desired effect.

Saugor Island was visited by my head clerk on the 12th January 1886. It was the first visit of inspection since the thermometer shed was erected and the Beckley's anemograph put up in position in 1880. The sites for the shed and the anemograph were selected by Mr. Eliot on his visit to the station in March 1878. The thermometer shed is of the standard pattern and is erected within the grounds of the telegraph office, and enclosed by a nulla and a mound of earth at a distance as a protection from inundation. The telegraph office building stands directly to the south or south-east of the shed at a distance of 38 feet from it. There are several trees very near to the shed, which have the effect of making the place very close and shady. The barometer is placed against the wall near the doorway leading into the signal room. It was originally placed in a wooden shed of the old telegraph office, and within the light-house compound, but the instrument has been in its present position since February 1880, in a good light, and at a height of 25·3 feet above the mean sea-level. A Fortin's instrument is in use, and it was found to be in good working order. The thermometers were found in good order.

The sun thermometer continues to be exposed on forked sticks at a height of 6 inches from the ground, as the same instrument has been in use since 1876. The Regulation stand has not been brought into use here. The rain-gauge in use was of old pattern, and 6 inches in diameter. The float of the gauge was lost, and the measurement of rainfall was made by means of a corresponding measure-glass. It was situated on the embankment, towards the south of the telegraph building. A new 5-inch rain-gauge has since been supplied and brought into use. The Beckley's anemograph is set up on the top of the watch tower of the telegraph office, and the cups of the anemometer are 51 feet above the ground. There are no objects near, higher than the building. The instrument

appeared to be set correctly, and its bearings were found well oiled. The condition of the observatory in charge of Mr. Peters, telegraph master, who has been for a long time connected with the Department, was highly satisfactory.

During the observership of Mr. Thomas, telegraph master, the grass minimum thermometer readings were found to be very low. An enquiry was made into the matter, and the result showed the defect in the readings was due to a break in the spirit column of the instrument, which was not noticed by the observer for months together. Mr. Thomas was therefore fined R15 in August 1885 for this gross carelessness. The grass readings for 18 months had to be rejected.

Eight of the 3rd class observatories were inspected during the year, *viz.*, Gya, Bankipore, Hazaribagh, Dacca, Darjeeling, Durbhunga, Jessore and Purneah.

Purneah was visited by my head clerk on 23rd June. He reported that the observatory shed had been removed to a new site, near the jail compound, by order of Mr. Eliot, owing to the erection of a building for the jailor's quarters close to the old site, but the conditions of exposure were almost identical with those of the abandoned site. The shed was in good order and the instruments clean and in working order, with the exception of the minimum thermometer, which had its column separated. The anemometer has become much shut in by the gradual growth of a row of high trees, that stand to the east and north-east of the instrument, at a distance of 60 yards. The average height of the trees is now 50 to 60 feet, while the anemometer is at a height of 25 or 26 feet above the ground. The medical officer (Dr. Picachy), in charge of the observatory, has been asked to select a more suitable site for the anemometer.

Darjeeling was visited on 16th November. As previously stated, the object of the inspection was to put the Beckley's anemograph in working order, as it had not worked for nearly two months, and the observer had not been able to put it right. The instrument was rendered effective. The other instruments were in good order, except the minimum thermometer, the column of which had slightly separated. The mercury in the cistern of the barometer was also cleaned, and the instrument put in good order. Mr. R. Carter, Rector, St. Paul's School, who is the Superintendent of the observatory, continues to take much interest in the observatory.

Bankipore was visited on 27th November by myself. The condition of the observatory was fairly satisfactory. Munshi Mohabat Lal, who has been the observer for some time, having been suspended from his appointment as head clerk, Temple Medical School, a brother clerk, who has had experience in meteorological work, has been temporarily put in charge of the observations. A higher rate of allowance had been sanctioned for the station by the recent arrangements in consideration of the fact that Munshi Mohabat Lal would reduce the observations himself and submit completed returns; but if the Munshi is not reinstated, and a new man is permanently appointed, the meteorological allowance will have to be reduced to R15, as at other third class stations, and the work of reduction and tabulation will be done in the central office.

Gya was visited on 16th December by Mr. Blanford, Meteorological Reporter to the Government of India. Mr. Blanford carefully verified the thermometers and the barometer in use, and the corrections of some of the thermometers were found to have altered. These instruments have therefore been recalled for re-verification. The worthlessness of the minimum readings at Gya was noticed in the previous administration reports. The real cause of this anomaly has been found to be that, since the introduction of the Bengal Daily Weather Report in 1883, the readings of the wet minimum thermometer have been reported to this office in the 10 A.M. telegrams instead of those of the dry minimum. The observer (Nowringee Lal) had been given ample opportunity to find out the cause of the erroneous minimum readings reported daily, but he failed to do so and the fact is fatal to his character as an observer. He was consequently fined two months' pay last year, and again a month's allowance (R15) in July 1885 for his continued inattention to the instructions he had received. The observer (Nowringee Lal) has gone on leave for six months, and advantage has been taken of this to appoint Mukund Lal, who had undergone practical training at the Bankipore observatory, to the observership.

Jessore was visited by my head clerk on 27th December. There has been no change in the site or exposure of the instruments, but there had been a very decided change for the worse in the observer, and most of the instruments were in bad order, and the observer's excuses for the state of the observatory were most paltry. In consequence the observer's special allowance has been suspended for six months.

Dacca observatory was visited by my head clerk on 20th January 1886. The barometer has been removed since 3rd May 1884 to the present position in the signal room of the telegraph office. It is now at an elevation of 21·7 feet above mean sea-level. The mercury in the cistern of the barometer was cleaned. The minimum thermometer had been out of order since November, and the observer had been unable to put it right, but the spirit column was easily restored. The anemometer was much in want of oil, and the observer neglected to take in the sun thermometer every night. The observatory was therefore not in very satisfactory order.

Hazaribagh was inspected on 27th March. The condition of the observatory was very satisfactory. All the instruments were found to be in perfectly good order. The point of greatest importance in the inspection was to solve certain discrepancies in the wind records of the Casella's anemograph. It was found that the principle on which the observer had worked hitherto was to make the embossed arrows on the paper correspond to the actual direction of the pointer of the wind-vane or to the absolute direction of the wind, and thus the N. embossed arrow on the paper made a very considerable angle with the line of the paper. The instrument was re-set, and the observer instructed how to keep the instrument in the required order. The observer was recommended for the continuance of the special allowance of ₹5 he had hitherto drawn.

Durbhunga observatory was inspected on 30th March. All the instruments were in perfectly good working order and the shed in excellent repair. The observer, Baboo Jogin Chunder Banerjee was the recipient of a five-rupee special allowance in 1883-84, but it was withdrawn for bad work. The observer was well reported on in 1884-85, and the condition of the observatory continuing to be equally good during 1885-86, he was restored to the special allowance for the ensuing year.

The remaining observatories of this class, *viz.*, Sibsagar, Cuttack, Chittagong, Berhampore, Silchar, Demagiri, False Point, Akyab, Tura, Tezpore and Burdwan, could not be visited during the year; but from the returns received, it may be presumed that their efficiency has been maintained in the majority of cases.

Sibsagar.—Baboo Dandadhar Dutt Barua has continued to do good work during the year, and the special allowance of ₹10 has therefore been continued to him during the ensuing year.

Cuttack.—Mr. Alley, telegraph master, was in charge throughout the year. The observations have been satisfactory and the returns punctual. He has been and is still the recipient of a five-rupee special allowance for meritorious services.

Chittagong.—The telegraph master in charge, Mr. Gabriel, has done his work well, and has been in charge of the observatory during the whole of the year. There were very few mistakes in the observations.

Berhampore.—The returns have been regular and satisfactory. Baboo Mahendra Nath Roy continues to be the observer. His special allowance of ₹10 has therefore been continued to him.

Silchar.—Mr. Blanford, Meteorological Reporter to the Government of India, visited this station early in 1884, and found that the shed was not built according to the standard plan. The observatory has hitherto been a most costly one, requiring yearly repairs, averaging ₹100. This was due to the shed being much larger than was necessary, and to the sole use of wood in its construction, which was rapidly destroyed by the attacks of white-ants. Mr. Blanford therefore sanctioned the erection of a more durable shed of standard dimensions supported on iron pillars. This has since been completed. The observer has submitted fairly satisfactory returns.

Demagiri.—This station has not been visited since it was started. The only instruments in use are a dry dulb and a maximum, a dry minimum thermometer and a wind-vane. The wind-vane was blown down by a storm and injured. The maximum and minimum thermometer readings have not been satisfactory. The civil hospital assistant of the Police Dispensary was in charge of the readings under the supervision of the civil medical officer. There is no allowance attached to this station, as it was established by the Deputy Commissioner of Chittagong Hill Tracts under the provisions of the rules for volunteer observers. The observations from this station are so far from satisfactory that they are frequently rejected.

False Point.—The observatory shed was blown down by the storm of September 23rd, which passed over this station and swept away Hookitola, which was also a rainfall-recording station. A very valuable set of observations was made at this station during the cyclone of this date by Mr. Workman, the observer. The telegraphic communication remained suspended from the 22nd

September 1885 to 6th January 1886, when the 10 A.M. telegrams were again resumed. The shed instruments were all saved by their timely removal, but the anemometer was blown down and badly injured. This has since been replaced by a new instrument. The records for the year were fairly satisfactory. Mr. Workman, light-house keeper, was formerly the observer on an allowance of ₹25 a month, but he having been appointed Port Officer, False Point, Mr. London succeeded to the post of meteorological observer on the reduced allowance of ₹20, and the observations are now being taken by him.

Akyab.—The registers have improved much. They were punctually received in this office.

Burdwan.—The observatory is apparently in excellent order, and the returns from this station have been satisfactory. Baboo Mokshoda Prasad Roy Chowdhury has well maintained his reputation, and has been recommended for the continuance of his special allowance of ₹10.

Tura.—The registers from this station have been of very doubtful value.

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ALEX. PEDLER,
Offg. Meteorological Reporter to the Government of Bengal.

METEOROLOGICAL OFFICE, BENGAL;
The 5th June 1886.

APPENDIX B.

Extract from the Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh.

The first class observatory at Allahabad obtained its full equipment in the beginning of March, and the full staff of observers has been entertained only since the 1st April. The new building in the Chatham lines, for the observatory in conjunction with the Meteorological Office, was not quite completed at the end of the year under report, but was already so far advanced in November that it could be occupied by the office. Very little progress was made during the cold weather, and it was not until the beginning of March that the arrangements for setting up the meteorograph were completed.

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Whilst the building was being got ready, the series of comparative thermometer readings at the old and new observatory sites, commenced in September 1884, was carried on; but from the 1st December only two complete sets of readings have been made at the old site instead of four as formerly, whereas at the new observatory four sets of observations have been made instead of two. On the removal of the office and the accompanying transformation of the new observatory into the principal one, the hour of the early morning observation was changed from 4 to 6 A.M., the latter being more convenient to the observers and more nearly coincident with the epoch of minimum temperature. It is, moreover, the hour adopted at the Alipore Observatory, Calcutta.

A summary of the comparative observations of temperature and humidity for the year under report is given in the Appendices. The series will be continued until the end of August, when a period of two years will be completed. The twelve months' observations in the Appendix show that the mean temperature at the new site is higher than at the old by about half a degree, and that the difference is greatest at the end of the rains, whilst at the hottest time of the year the old site is slightly hotter than the new. The minimum temperatures do not differ much in any month, nor do the maxima, except in the hot-weather months, when they are about a degree lower at the new site than at the old. The excess of the mean at the new site is due to the higher temperature of the forenoons and afternoons, as indicated by the observations made at 10 A.M. and 4 P.M.

These differences are all explained by the circumstances that the new site is on an open breezy plain, covered in the rainy season with grass cropped short by grazing cattle, whilst the old site is in

a hollow surrounded by trees, and in the rains and for some time afterwards, covered with long grass and other vegetation. The trees cut off the morning and afternoon sun, but not the mid-day sun; and as the air does not circulate so freely as at the new site, a higher temperature is attained at the hottest time of the day, in those months when the wind velocity is highest. In the months at the end of the rains, when there is little or no wind, the maximum temperatures would probably be equal were it not that the old site is rendered slightly cooler by the vegetation and consequent evaporation. At this season also, the foliage of the trees is densest and cuts off the morning and afternoon sun most completely.

The humidity observations, on the whole, bear out this explanation, but during the three months of the dry hot weather, there was apparently a slight excess of humidity at the new site, not easily explicable.

The nocturnal radiation thermometer gave uniformly lower indications at the new site than at the old, as was to be expected. The differences of the solar radiation thermometers are so great and irregular that they are only explicable on the assumption that the two instruments (which are supposed to be corrected to a common standard) are not comparable, except when exposed side by side under absolutely identical conditions. That a very slight change of position alters the indications of these instruments, owing to a change in the quantity of heat they receive from surrounding objects, has been recently and unexpectedly rendered evident, by the inadvertent vitiation of the long series of observations made with the instrument in use at the old site, which has fortunately escaped breakage since January 1876. In 1884, the position of this instrument was changed, to make room for the tower mentioned in last year's report—a change which I did not discover until this year. The instrument was placed 3 or 4 yards nearer to a small mango tree, the result being a permanent rise of its indications empirically determined to be about 2° Fahrenheit. As the long series of observations at the old site has thus been interrupted, and the observations were certain to be discontinued at the end of August, the instrument has now been removed to the new observatory, where it will again be compared with the one in use there.

* * * * * * * * *

Since the removal of the Meteorological Office and the observatory head-quarters to the new building last November, the hourly observations kept up, as at the second class stations, for nearly ten years, have been abandoned. The observations, now made, comprise a full set of pressure, temperature, humidity, wind, rain, cloud, and general weather observations five times daily, besides the continuous registration of the first five of these elements by the Van Rysselberghe meteorograph; also observations of ground temperature, and of the temperature and humidity in the thermograph penthouse and in a similar penthouse near the top of the tower three times a day, these latter being made with a view to determine the variation of temperature and humidity with height above the ground; and, in addition to all the above, observations of special instruments, such as the sunshine recorder, the nephescope, and Frankland's solar thermometer.

S. A. HILL,

Meteorological Reporter to the Government,
North-Western Provinces and Oudh.

Comparison of shade temperatures at the New Observatory, Chatham Lines, Allahabad, with those simultaneously recorded at the old site.

Month.	Mean temperature.*			Mean at 10 A.M.			Mean at 4 P.M.			Mean maxima.			Mean minima.			Mean daily range.		
	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.
April 1885	86·1	85·9	+0·2	92·0	92·9	−0·9	99·3	99·0	+0·3	101·1	102·0	−0·9	71·9	71·6	+0·3	29·2	30·4	−1·2
May „	88·6	88·7	−0·1	93·9	94·8	−0·9	101·1	100·9	+0·2	102·5	103·8	−1·3	74·9	75·0	−0·1	27·6	28·8	−1·2
June „	92·0	92·6	−0·6	95·1	95·7	−0·6	100·0	100·2	−0·2	102·2	103·4	−1·2	82·9	83·0	−0·1	19·4	20·4	−1·0
July „	84·4	84·3	+0·1	85·7	85·7	0·0	89·0	88·4	+0·6	90·8	91·0	−0·2	79·1	79·3	−0·2	11·7	11·7	·0
August „	81·6	81·3	+0·3	83·4	83·1	+0·3	84·7	84·2	+0·5	87·1	87·4	−0·3	77·8	77·6	+0·2	9·3	9·8	−0·5
September „	83·0	82·4	+0·6	87·0	86·4	+0·6	90·0	88·7	+1·3	92·0	92·0	·0	76·1	75·8	+0·3	15·9	16·2	−0·3
October „	78·2	76·9	+1·3	84·8	82·9	+1·9	91·5	88·2	+3·3	92·6	91·8	+0·8	66·4	66·3	+0·1	26·2	25·5	+0·7
November „	68·3	66·7	+1·6	77·6	74·0	+3·6	83·8	80·2	+3·6	84·7	84·3	+0·4	54·0	54·1	−0·1	30·7	30·2	+0·5
December „	59·8	59·1	+0·7	63·9	62·6	+1·3	69·9	68·6	+1·3	71·4	70·9	+0·5	50·2	50·8	−0·6	21·2	20·1	+1·1
January 1886	59·9	59·1	+0·8	64·6	62·5	+2·1	72·4	70·9	+1·5	73·6	73·0	+0·6	48·1	48·3	−0·2	25·6	24·7	+0·9
February „	62·9	62·5	+0·4	67·3	66·2	+1·1	77·8	77·1	+0·7	78·6	78·9	−0·3	49·4	49·5	−0·1	29·2	29·5	−0·3
March „	76·1	75·4	+0·7	81·5	80·7	+0·8	88·8	88·3	+0·5	90·3	91·0	−0·7	63·0	62·4	+0·6	27·3	28·6	−1·3
Year	76·7	76·2	+0·5	81·4	80·6	+0·8	87·4	86·3	+1·1	88·9	89·1	−0·2	66·1	66·1	·0	22·8	23·0	−0·2

* Computed by means of variable corrections proportional to the range, from the 10 A.M., 4 P.M., maximum and minimum observations.

Comparison of the readings of the radiation thermometers taken at the Old and New Observatories, Allahabad.

Month.	Sun radiation thermometer.			Nocturnal radiation thermometer.		
	New.	Old.	Difference.	New.	Old.	Difference.
April 1885	162·1	162·3	−0·2	60·3	62·0	−1·7
May „	163·7	163·6	+0·1	64·2	66 8	−2·6
June „	162·5	160·9	+1·6	76·5	77·8	−1·3
July „	149·4	145·3	+4·1	77·0	77·4	−0·4
August „	146·4	140·2	+6·2	76·1	76·2	−0·1
September „	153·0	152·2	+0·8	71·9	71·9	·0
October „	152·4	152·3	+0·1	57·8	58·8	−1·0
November „	143·8	146·4	−2·6	43·6	45·0	−1·4
December „	124·2	125·3	−1·1	41·4	43·4	−2·0
January 1886	133·4	135·4	−2·0	37·8	39 6	−1·8
February „	144·1	140·9	+3·2	37·8	40·3	−2·5
March „	156·3	152·6	+3·7	52·5	55·0	−2·5
Year	149·3	148·1	+1·2	58·1	59·5	−1·4

Comparative observations of atmospheric humidity at the Old and New Observatories, Allahabad.

Month.	Vapour tension in inches of mercury.						Relative humidity or percentage of saturation.					
	Mean.			At 10 A.M.			Mean.			At 10 A.M.		
	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.	New.	Old.	Difference.
April 1885	·388*	·373*	+·015	·411	·384	+·027	33*	32*	+1	28	26	+2
May „	·488	·458	+·030	·509	·477	+·032	39	37	+2	34	31	+3
June „	·747	·722	+·025	·756	·736	+·020	53	51	+2	49	47	+2
July „	·944	·974	−·030	·970	·999	−·029	79	83	−4	79	81	−2
August „	·932	·954	−·022	·941	·967	−·026	86	88	−2	82	85	−3
September „	·851	·871	−·020	·893	·904	−·011	74	77	−3	70	72	−2
October „	·559	·615	−·056	·601	·620	−·019	57	64	−7	50	55	−5
November „	·375	·398	−·023	·405	·392	+·013	54	60	−6	45	47	−2
December „	·376	·389	−·013	·394	·392	+·002	72	75	−3	67	69	−2
January 1886	·351	·359	−·008	·380	·366	+·014	66	70	−4	62	64	−2
February „	·256	·308	−·052	·264	·294	−·030	45	54	−9	39	45	−6
March „	·428	·454	−·026	·455	·481	−·026	49	53	−4	43	46	−3
Year	·558	·573	−·015	·582	·584	−·002	59	62	−3	54	56	−2

* Crude mean of 10 A.M. and 4 P.M. and minimum observations.

APPENDIX C.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86.

Province.	Observatory.	Class.	Names of Superintendents.	Period. From	Period. To	Names of Observers.	Period. From	Period. To
Bengal and Assam.	Sibsagar	Third	Civil Surgeon	1st April 1885	31st Mar. 1886	Dandadhar Dutt, Burua	1st April 1885	31st Mar. 1886.
	Dhubri	Second	Dr. Edwin Dobson	1st April 1885	31st Mar. 1886	Munshi Kadimuddin Ahmed	1st April 1885	31st Mar. 1886.
						Ambica Prosad Dey (*Assistant*)	1st April 1885	16th April 1885.
						Munshi Kafayat Ulla (*Do.*)	26th April 1885	31st Mar. 1886.
	Silchar	Third	Civil Surgeon	1st April 1885	31st Mar. 1886	Romesh Chundra Bhadra	1st April 1885	31st Mar. 1886.
	Tezpore	Ditto	Ditto	2nd April 1885	31st Mar. 1886	Joggeshwar Dass	2nd April 1885	6th Nov. 1885.
							19th Mar. 1886	31st Mar. 1886.
						Narayan Chandra Basu	6th Jan. 1886	18th Mar. 1886.
						Shufget Hossain	7th Nov. 1885	5th Jan. 1886.
	Patna	Ditto	Ditto	1st April 1885	31st Mar. 1886	Munshi Mohabat Lall	1st April 1885	27th Jan. 1886.
						Surjan Singh	28th Jan. 1886	31st Mar. 1886.
	Hazaribagh	Ditto	Ditto	1st April 1885	31st Mar. 1886	Nuthoo Lall	1st April 1885	31st Mar. 1886.
	Saugor Island	Second	.....	.....	.....	Mr. J. A. Thomas	1st April 1885	17th Sept. 1885.
						,, W. Cahill	18th Sept. 1885	14th Nov. 1885.
						,, R. H. Peters	15th Nov. 1885	31st Mar. 1886.
	Cuttack	Third	.....	.....	.....	,, H. W. Alley	1st April 1885	31st Mar. 1886.
	Chittagong	Ditto	.....	.....	.....	,, J. E. Gabriel	1st April 1885	31st Mar. 1886.
	Darjeeling	Ditto	Rector, St. Paul's School.	1st April 1885	31st Mar. 1886	,, W. Moore	1st April 1885	31st Mar. 1886.
	Purneah	Ditto	Civil Medical Officer	1st April 1885	31st Mar. 1886	Rajoni Kanta Chuckerbutty	1st April 1885	17th July 1885.
						Matilal Roy	18th July 1885	27th Dec. 1885.
						Lalit Mohun Banerjee	28th Dec. 1885	31st Mar. 1886.
	Durbhanga	Ditto	Civil Surgeon	1st April 1885	31st Mar. 1886	Jogin Chunder Banerjee	1st April 1885	31st Mar. 1886.
	Gya	Ditto	Ditto	1st April 1885	31st Mar. 1886	Nowringee Lall	1st April 1885	31st Dec. 1885.
						Mukund Lall	1st Jan. 1886	31st Mar. 1886.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86—continued.

Province.	Observatory.	Class.	Names of Superintendents.	Period		Names of Observers.	Period	
				From	To		From	To
Bengal and Assam—*concld.*	Berhampore	Third	Civil Surgeon	1st April 1885	31st Mar. 1886	Mohendra Nath Roy	1st April 1885	31st Mar. 1886.
	Burdwan	Ditto	Ditto	1st April 1885	31st Mar. 1886	Mokhoda Prasad Chowdhury	1st April 1885	31st Mar. 1886.
	Jessore	Ditto	Ditto	1st April 1885	31st Mar. 1886	Paresh Nath Roy Chowdhury	1st April 1885	31st Mar. 1886.
	Dacca	Ditto	.....	.....	.....	Mr. T. W. DeSouza	1st April 1885	31st Mar. 1886.
	False Point	Ditto	.....	.....	.....	Mr. E. Workman	1st April 1885	23rd Sept. 1885.
						,, J. London	24th Sept. 1885	31st Mar. 1886.
	Demagiri	Fourth	Civil Medical Officer	1st April 1885	31st Mar. 1886	Grish Chundra Bhar	1st April 1885	18th April 1885.
							26th May 1885	31st Mar. 1886.
						Rajany Kanta Bose	19th April 1885	25th May 1885.
	Mongpoo	Ditto	.....	.....	.....	Mr. George A. Gammie	1st April 1885	31st Mar. 1886.
	Tura	Ditto	Civil Medical Officer	1st April 1885	31st Mar. 1886	Abdul Majeem	1st April 1885	31st Mar. 1886.
	Pedong	Third	.....	.....	.....	Revd. Father A. Disgodins, S.J.	1st April 1885	22nd Mar. 1886.
						,, ,, Hervagault, S.J.	23rd Mar. 1886	31st Mar. 1886.
N.-W. Provinces and Oudh.	Allahabad	First	S. A. Hill, Esq., B.Sc.	1st April 1885	31st Mar. 1886	Kedar Nath Chatterjee	1st April 1885	31st Mar. 1886.
						Sosibhusan Banerjee (*Asst.*)	1st April 1885	31st May 1885.
						Nand Lal (*Asst.*)	1st June 1885	30th June 1885.
						Makham Lal Mukerjee (*Asst.*)	1st July 1885	31st July 1885.
						Nand Lal (*Asst.*)	1st Aug. 1885	31st Dec. 1885.
						Sosibhusan Banerjee (*Asst.*)	1st Jan. 1886	31st Mar. 1886.
	Agra	Third	Dr. A. H. Hilson	1st April 1885	27th Aug. 1885	Mir Altaf Ali	1st April 1885	31st Mar. 1886.
			,, W. Moir	28th Aug. 1885	26th Feb. 1886	Abdul Majid Khan (*Asst.*)	1st April 1885	31st Dec. 1885.
			,, A. H. Hilson	27th Feb. 1886	31st Mar. 1886			
	Lucknow	Ditto	,, J. C. Whishaw	1st April 1885	15th Feb. 1886	Chotay Lal	1st April 1885	31st Mar. 1886.
			,, J. Sykes	16th Feb. 1886	5th Mar. 1886	Durga Parshad (*Asst.*)	1st April 1885	31st Dec. 1885.
			,, J. Cleghorn	6th Mar. 1886	31st Mar. 1886			
	Roorkee	Ditto	Capt. Harrison, R.E.	1st April 1885	30th June 1885	Chiranji Lal	1st April 1885	31st Mar. 1886.
			Dr. Murray Thomson	1st July 1885	31st Mar. 1886	Gunga Ram (*Asst.*)	1st April 1885	31st Dec. 1885.

N.-W. Provinces and Oudh—*concld.*	Chakrata	Third	Captain A. E. Ward	1st April 1885	19th May 1885	Salig Ram	1st April 1885	8th Nov. 1885.
			,, E. Glennie, R.E.	20th May 1885	19th July 1885	Bunwari Lal	9th Nov. 1885	2nd Dec. 1885.
			Lieutenant J. A Tanner, R.E.	20th July 1885	31st Oct. 1885	Corporal Sellers	3rd Dec. 1885	3rd Mar. 1886.
			Serjeant W. Chalmer	1st Nov. 1885	10th Mar. 1886	Bunwari Lal	4th Mar. 1886	31st Mar. 1886.
	Ranikhet	Ditto	Captain T. Digby, R.E.	11th Mar. 1886	31st Mar. 1886			
			.....	.....	.....	Jewanand	1st April 1885	31st Mar. 1886.
	Dehra (S.G.O.)	Ditto	Deputy Superintendent, Survey of India.	1st April 1885	31st Mar. 1886	The Computers	1st April 1885	31st Mar. 1886.
	Bareilly	Ditto	E. A. Phillips, Esq.	1st April 1885	28th June 1885	M. Jwala Parshad	1st April 1885	30th Sep. 1885.
			H. O. Budden, Esq.	1st July 1885	31st Mar. 1886	M. Sundar Lal	1st Oct. 1885	31st Mar. 1886.
	Meerut	Ditto	Dr. W. Moir	1st April 1885	21st Aug. 1885	Harsaran Das	1st April 1885	31st Mar. 1886.
			,, R. Jameson	22nd Aug. 1885	27th Sep. 1885			
			,, O. Todd	28th Sep. 1885	31st Oct. 1885			
			,, E. A. FitzGerald	1st Nov. 1885	28th Feb. 1886			
			,, W. Moir	1st Mar. 1886	31st Mar. 1886			
	Gorakhpur	Ditto	,, C. Prentis	1st April 1885	31st Mar. 1886	Nizam-ud-din	1st April 1885	31st Mar. 1886.
	Ghazipur	Ditto	,, P. A. Weir	1st April 1885	31st Mar. 1886	Babu Mahabir	1st April 1885	31st Mar. 1886.
	Benares	Ditto	,, G. Thibaut	1st April 1885	31st Mar. 1886	Deoki Nandan Pathak	1st April 1885	15th Mar. 1886.
						Ram Ratna Pathak	16th Mar. 1886	31st Mar. 1886.
	Jhansi	Ditto	Surgeon-Major W. E. Moynan	1st April 1885	31st Mar. 1886	Kalka Das	1st April 1885	31st Mar. 1886.
	Pithoragarh	Ditto	Dr. S. Deasee	1st April 1885	31st Mar. 1886	Sher Singh	1st April 1885	31st Mar. 1886.
			,, E. Lawri	1st April 1885	9th April 1885			
	Lahore	Second	J. C. Oman, Esq.	10th April 1885	30th Nov. 1885	Jasput Rai	1st April 1885	31st Mar. 1886.
			W. L. Dallas, Esq.	1st Dec. 1885	31st Jan. 1886	Devan Chand (*Asst.*)	1st April 1885	31st Mar. 1886.
			J. C. Oman, Esq.	1st Feb. 1886	31st Mar. 1886			
Punjab	Mooltan	Third	Dr. T. E. L. Bate	1st April 1885	24th Mar. 1886	Wahid Ally Shah	1st April 1885	31st Mar. 1886.
			Sahib Ditta Mull	25th Mar. 1886	31st Mar. 1886			
	Dera Ismail Khan	Ditto	Surgeon-Major A. P. Holmes	1st April 1885	1st July 1885			
			Dr. C. Macartie	2nd July 1885	30th Sep. 1885	Noor Bukhsh	1st April 1885	25th May 1885.
			Surgeon-Major A. P. Holmes	1st Oct. 1885	26th Oct. 1885	Golam Mahmed	26th May 1885	8th July 1885.
			Dr. Duncan	27th Oct. 1885	31st Jan. 1886	Noor Bukhsh	9th July 1885	31st Mar. 1886.
			,, C. Macartie	1st Feb. 1886	31st Mar. 1886			

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86—continued.

Province.	Observatory.	Class.	Names of Superintendents.	Period From	Period To	Names of Superintendents.	Period From	Period To
Punjab—*concld.*	Peshawar	Third	Dr. W. Coates	1st April 1885	30th Jan. 1886	Kashi Ram	1st April 1885	31st Mar. 1886.
			,, T. C. Chatterjee	21st Jan. 1886	29th Jan. 1886			
			,, G. F. Nicholson	30th Jan. 1886	31st Mar. 1886			
	Rawalpindi	Ditto	,, J. Bennet	1st April 1885	31st July 1885	Kalee Nath Rai	1st April 1885	31st Mar. 1886.
			,, S. J. Grant	1st Aug. 1885	2nd Nov. 1885			
			,, G. Nicholson	3rd Nov. 1885	20th Nov. 1885			
			,, J. Massey	21st Nov. 1885	31st Mar. 1886			
	Murree	Ditto	Geog. Peak, L.M.S.	1st April 1885	31st Mar. 1886	Mr. Cruickshank	1st April 1885	31st Mar. 1886.
	Sialkot	Ditto	Babu Sunder Mull	1st April 1885	24th April 1885	Babu Sunder Mull	1st April 1885	2nd April 1885.
			Dr. E. Palmer	25th April 1885	5th July 1885	Sardar Khan	3rd April 1885	31st Mar. 1886.
			Babu Sunder Mull	6th July 1885	26th Oct. 1885			
			Dr. W. A. O'Roe	27th Oct. 1885	31st Mar. 1886			
	Ludhiana	Ditto	Bhugwan Dass	1st April 1885	31st Mar. 1886	Brij Lall	1st April 1885	31st Mar. 1886.
	Chamba	Ditto	.....	.....	.....	Dr. Burkhurdar Khan	1st April 1885	31st Mar. 1886.
	Simla	Ditto	Quarter Master General, India	1st April 1885	31st Mar. 1886	J. J. Konigs	1st April 1885	31st Mar. 1886.
	Kailang	Ditto	Revd. A. W. Heyde	1st April 1885	31st Mar. 1886	T. Dana	1st April 1885	31st Mar. 1886.
	Delhi	Ditto	Dr. G. C. Ross	1st April 1885	16th April 1885	Bunsee Dhar	1st April 1885	31st Mar. 1886.
			,, J. A. Cunningham	17th April 1885	20th Oct. 1885			
			,, G. C. Ross	21st Oct. 1885	26th Mar. 1886			
			,, T. E. L. Bate	27th Mar. 1886	31st Mar. 1886			
	Sirsa	Ditto	.....	.....	.....	Lachman Dass	1st April 1885	8th May 1885.
						Permanand	9th May 1885	30th Mar. 1886.
	Nagpur	Second	Surgeon-Major R. T. Wright, M.D.	1st April 1885	7th May 1885	P. Soobiah	1st April 1885	31st Mar. 1886.
			T. F. Barter	8th May 1885	13th July 1885	Abed Hoosein (*Asst.*)	1st April 1885	31st Mar. 1886.
			,, R. T. Wright, M.D.	14th July 1885	23rd Jan. 1886			
			,, T. F. Barter	24th Jan. 1886	7th Feb. 1886			
			,, R. T. Wright, M.D.	8th Feb. 1886	31st Mar. 1886			

	Jubbulpore	Ditto	Brigade Surgeon W. R. Rice, M.D.	1st April 1885	10th May 1885	Sadhuram Dubey	1st April 1885	31st Mar. 1886.
			Surgeon-Major R. T. Wright M.D.	11th May 1885	6th July 1885			
			Brigade Surgeon W. R. Rice, M.D.	7th July 1885	31st Mar. 1886	Ramlogan Singh (*Asst.*)	1st April 1885	31st Mar. 1886.
	Pachmarhi	Ditto	Surgeon-Major R. Drury	1st April 1885	31st Mar. 1886	Pandit Krishna Rao	1st April 1885	28th Feb. 1886.
						T. M. Venkatachelem Pillay	1st Mar. 1886	31st Mar. 1886.
						T. M. Venkatachelm Pillay (*Asst.*)	1st April 1885	28th Feb. 1886.
						P. Raja Ruthnum (*Asst.*)	1st Mar. 1886	31st Mar. 1886.
	Saugor	Ditto	,, W. H. Booth	1st April 1885	13th Nov. 1885	Narain Rao	1st April 1885	24th Feb. 1886.
			,, J. B. Gaffney	14th Nov. 1885	31st Mar. 1886	Jadunath Bose	25th Feb. 1886	31st Mar. 1886.
	Hoshangabad	Ditto	Surgeon C. Henderson	1st April 1885	31st March 1886	Jadunath Bose	1st April 1885	24th Feb. 1886.
						Narain Rao	25th Feb. 1886	9th Mar. 1886.
CENTRAL PROVINCES.						Govind Vithal	10th Mar. 1886	31st Mar. 1886.
	Seoni	Ditto	Surgeon-Major J. B. Gaffney	1st April 1885	31st Aug. 1885	Punchum	1st April 1885	31st Mar. 1886.
			,, H. K. McKay	1st Sept. 1885	31st Mar. 1886			
	Khandwa	Ditto	,, D. Cullen	1st April 1885	25th May 1885	Beharilal Parasar	1st April 1885	31st March 1886.
			,, G. R. Dapthary, M.D.	26th May 1885	18th Aug. 1885			
			Surgeon S. H. Browne, M. D.	19th Aug. 1885	31st Mar. 1886			
	Chanda	Ditto	Assistant Surgeon Shibchunder Bhattercharjee	1st April 1885	22nd Nov. 1885	Seetaram	1st April 1885	31st March 1886.
			Surgeon-Major B. Evers, M D.	23rd Nov. 1885	31st Mar. 1886			
	Sironcha	Ditto	Narahar Govind, Tahsildar	1st April 1885	31st March 1886	Moothu Krishna Naidoo	1st April 1885	31st March 1886.
	Raipur	Ditto	Brigade Surgeon D. W. Trimnell	1st April 1885	31st Mar. 1886	Krishna Rao	1st April 1885	18th June 1885.
						Mr. Aggis	19th June 1885	20th Aug. 1885.
						Govind Ramchundra	21st Aug. 1885	31st Mar. 1886.
	Sambalpur	Ditto	Surgeon J. L. Poynder	1st April 1885	29th Oct. 1885	Syed Mahomed Hyder Hasseni Hydri	1st April 1885	8th Oct. 1885.
			,, Pedroza	30th Oct. 1885	31st Dec. 1885			
			,, J. L. Poynder	1st Jan. 1886	31st Mar. 1886	Annanth Ram Behara	9th Oct. 1885	31st Mar. 1886.
	Akola	Ditto	Surgeon J. J. Moran	1st April 1885	31st Mar. 1886	Samuel Gregory	1st April 1885	31st Mar. 1886.
						Husseni Beg	1st April 1885	31st May 1885.
BERAR						Shanker Ramrao	1st June 1885	31st July 1885.
	Buldana	Ditto	Apothecary Dr. Callaghan	1st April 1885	31st Mar. 1886	Abdul Karim	1st Aug. 1885	4th Sept. 1885.
						Luxmon Vinayek	5th Sept. 1885	14th Nov. 1885.
						Waman Pandurang	15th Nov. 1885	31st Mar. 1886.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86.—continued.

Province.	Observatory.	Class.	Names of Superintendents.	Period		Names of Observers.	Period	
				From	To		From	To
Berar—*concld.*	Chikalda	Third	Surgeon R. James	1st April 1885	17th June 1885	Hiralal	1st April 1885	31st March 1886.
			Assistant Apothecary W. Hendricks	18th June 1885	17th Aug. 1885			
			Surgeon R. James	18th Aug. 1885	25th Mar. 1886			
			Assistant Apothecary W. Hendricks	26th Mar. 1886	31st Mar. 1886			
	Amraoti	Ditto	Surgeon T. Hume	1st April 1885	16th April 1885	Bukaram Pandurang	1st April 1885	31st Mar. 1886.
			,, R. B. Roe	17th April 1885	13th July 1885			
			,, T. Hume	14th July 1885	31st Mar. 1886			
	Makhla	Fourth	J. Balantine	1st April 1885	31st Mar. 1886	Papannah	1st April 1885	31st Mar. 1886.
	Jeypur	First	Surgeon-Major T. H. Hendley	1st April 1885	31st Mar. 1886	Durga Pershad	1st April 1885	31st Mar. 1886.
						Nathu Narayan	1st April 1885	31st Mar. 1886.
						Sheo Pertab	1st April 1885	31st Mar. 1886.
	Sutna	Third	,, S. J. Goldsmith	1st April 1885	31st Mar. 1886	Pandit Harnath	1st April 1885	31st Mar. 1886.
	Nowgong	Ditto	John Mather, Esq.	1st April 1885	31st Mar. 1886	Baldeva Parshad	1st April 1885	31st Mar. 1886.
	Neemuch	Ditto	Surgeon-Major E. C. R. Ward	1st April 1885	15th July 1885			
			Surgeon C. E. Nichol	16th July 1885	7th Sept. 1885	T. Bachu	1st April 1885	7th Feb. 1886.
			,, S. J. Flood	8th Sept. 1885	15th Oct. 1885	Ramji Khandriji	8th Feb. 1886	23rd Feb. 1886.
			,, C. Nichol	16th Oct. 1885	15th Nov. 1885	T. Bachu	24th Feb. 1886	31st Mar. 1886.
			Surgeon-Major F. Falwasser	16th Nov. 1885	31st Jany. 1886			
			Surgeon J. Lucas	1st Feby. 1886	8th Mar. 1886			
			,, D. V. O'Connell	9th Mar. 1886	31st Mar. 1886			
Central India and Rajputana.	Indore	Ditto	Surgeon-Major D. F. Keegan	1st April 1885	11th Aug. 1885	Trimbakrao	1st April 1885	31st Mar. 1886.
			,, R. Caldecott	12th Aug. 1885	9th Nov. 1885			
			,, D. F. Keegan	10th Nov. 1885	27th Mar. 1886			
			,, R. Caldecott	28th Mar. 1886	31st Mar. 1886			
	Mount Abu	Ditto	Surgeon-Major R. H. Robinson	1st April 1885	31st Dec. 1885	S. K. Gadgil	1st April 1885	1st May 1885.
			Assistant Apothecary J. W. Ranger	1st Jan. 1886	31st Mar. 1886	M. M. Talati	25th July 1885	31st Mar. 1886.

	Pachpadra	Ditto	G. A. Bradford	1st April 1885	31st Mar. 1886	Murat Lall	1st April 1885	18th Oct. 1885.
						P. Halder	19th Oct. 1885	12th Feb. 1886.
						G. C. Banerji	13th Feb. 1886	24th Feb 1886.
						P. Halder	25th Feb. 1886	31st Mar. 1886.
	Ajmere	Ditto	Surgeon-Major J. H. Newman, M.D.	1st April 1885	31st Mar. 1886	Ram Parshad	1st April 1885	31st Mar. 1886.
	Sambhar	Ditto	F. Ashton, Esq.	1st April 1885	31st Mar. 1886	Muhammed Habibulla Khan	1st April 1885	31st Mar. 1886.
	Bickaneer	Ditto	.....	.....	.....	Ram Lall	1st April 1885	21st May 1885.
						Luchmandas	22nd May 1885	31st Mar. 1886.
	Belgaum	Second	Surgeon-Major W. J. Campbell	1st April 1885	30th April 1885	Ram Chandra Datta	1st April 1885	31st Mar. 1886.
			,, R. P. Ferguson	1st May 1885	31st Mar. 1886	Shantaram Wassudev (*Asst.*)	1st April 1885	7th April 1885.
						Balaji Krishna (*Asst.*)	10th April 1885	31st Mar. 1886.
	Yerrowda (Poona)	Ditto	,, S. M. Solomon	1st April 1885	31st Mar. 1886	Narayen S. Kelkar	1st April 1885	31st Mar. 1886.
						C. S. Moodliar (*Asst.*)	1st April 1885	23rd Oct. 1885.
						Krishnaji Narain ,,	30th Oct. 1885	28th Feb. 1886.
						G. C. Moodliar ,,	1st Mar. 1886	31st Mar. 1886.
			,, W. P. Bridges	1st April 1885	1st April 1885			
			Surgeon C. B. Maitland	2nd April 1885	17th April 1885			
			Surgeon-Major W. P. Bridges	18th April 1885	30th April 1885			
	Deesa	Ditto	Surgeon C. B. Maitland	1st May 1885	30th May 1885	Ramkrishna Keshav	1st April 1885	31st Mar. 1886.
			Surgeon-Major W. P. Bridges	31st May 1885	19th Nov. 1885	Doyal Bhala (*Asst.*)	1st April 1885	31st Mar. 1886.
BOMBAY			Surgeon A. S. Falkner	20th Nov. 1885	18th Dec. 1885			
			Surgeon-Major W. P. Bridges	19th Dec. 1885	31st Mar. 1886			
	Kurrachee	Ditto	Brigade Surgeon C. H Girand	1st April 1885	31st Mar. 1886	Minguel Fernandez	1st April 1885	31st Mar. 1886.
						Hassan Kádar (*Asst.*)	1st April 1885	31st Mar. 1886.
	Jacobabad	Third	Surgeon B. N. Koyaji	1st April 1885	30th Dec. 1885	Sheikh Ali	1st April 1885	31st Mar. 1886.
			,, A. Milve	31st Dec. 1885	28th Feb. 1886			
			,, H. Adey	1st Mar. 1886	31st Mar. 1886			
	Hyderabad (Sind)	Ditto	Surgeon-Major R. M. Craig	1st April 1885	31st May 1885	S. Pais	1st April 1885	31st May 1885.
			Surgeon H. Adey	1st June 1885	18th June 1885	Mahmed Yubiff	1st June 1885	13th Jan. 1886.
			Surgeon-Major H. De Fatham	19th June 1885	31st Mar. 1886	Kison Sing	14th Jan. 1886	21st Jan. 1886.
						Hussan Khan	22nd Jan. 1886	31st Mar. 1886.
	Bhuj	Ditto	,, F. Jones	1st April 1885	31st Mar. 1886	Shankerji Naronji	1st April 1885	31st Mar. 1886.

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86—continued.

Province.	Observatory.	Class.	Names of Superintendents.	Period		Names of Observers.	Period	
				From	To		From	To
Bombay—*concld.*	Rajkot	Third	Surgeon-Major S. B. Haliday	1st April 1885	31st Jan. 1886	Hurry Sing Ruttan Sing	1st April 1885	30th Mar. 1886.
			Surgeon J. Wilkins	1st Feb. 1886	31st Mar. 1886			
	Sholapur	Ditto	W. R. Scroggie, Esq., M.R.C.P.	1st April 1885	31st Mar. 1886	Balwant Laxman	1st April 1885	31st Mar. 1886.
	Surat	Ditto	Surgeon-Major H. A. Lewis	1st April 1885	28th April 1885	Chhagan Lal Huri Lal	1st April 1885	31st Mar. 1886.
			,, S. O. B. Banks	29th April 1885	16th June 1885			
			,, H. Atkins	17th June 1885	25th June 1885			
			,, S. O. B. Banks	26th June 1885	30th Sept. 1885			
			Asstt. Surgeon Dassabhoy Pestanji	1st Oct. 1885	31st Dec. 1885			
			Surgeon-Major S. O. B. Banks	1st Jan. 1886	31st Mar. 1886			
	Malegaon	Ditto	No Superintendent	1st April 1885	14th April 1885	Shaikh Mohamed	1st April 1885	31st Mar. 1886.
			Surgeon A. F. Ferguson	15th April 1885	11th June 1885			
			No Superintendent	12th June 1885	31st Mar. 1886			
	Ratnagiri	Ditto	Surgeon H. McColman	1st April 1885	31st Mar. 1886	Mahadev Cuddum	1st April 1885	31st Mar. 1886.
	Karwar	Ditto	R. G. C. Westbrook, Esq.	1st April 1885	4th Jan. 1886	G. W. M. D'Aranjo	1st April 1885	31st Mar. 1886.
			A. R. Maidment, Esq.	5th Jan. 1886	7th Mar. 1886			
			R. G. C. Westbrook, Esq.	8th Mar. 1886	31st Mar. 1886			
	Bellary	Second	Surgeon-Major H. M. G. Archdall	1st April 1885	9th June 1885	B. G. Sashachellum Naidu	1st April 1885	13th July 1885.
			Surgeon H. Thompson, M.B.	10th June 1885	24th June 1885	P. Namasiroyam Pillay	14th July 1885	13th Aug. 1885.
			Surgeon-Major T. J. H. Wilkins	25th June 1885	5th Nov. 1885	B. G. Sashachellum Naidu	14th Aug. 1885	31st Mar. 1886.
			Asst. Surgeon W. D. Bartley	6th Nov. 1885	30th Nov. 1885	Sreenivasa Row, (*Asst.*)	1st April 1885	31st Mar. 1886.
			Surgeon T. H. Pope, M.B.	1st Dec. 1885	31st Mar. 1886			
						T. Lutchman Row	1st April 1885	31st Mar. 1886.
	Trichinopoly	Ditto	Surgeon-Major L. C. Nanney, M.D.	1st April 1885	5th Aug. 1885	E. M. Bhojarajulu Naidu (*Asst.*)	1st April 1885	22nd April 1885.
			,, H. Hyde	6th Aug. 1885	31st Mar. 1886	E. R. Sathoo Row (*Asst.*)	23rd April 1885	31st Mar. 1886.
	Gopalpore	Third	Port Officer	1st April 1885	31st Mar. 1886	G. Appalanarasimhum	1st April 1885	31st Dec. 1885.
						J. Suneasi Row	1st Jan. 1886	31st Mar. 1886.

MADRAS	Masulipatam	Ditto	Surgeon-Major J. B. Thomas, L. R. C.P.L.	1st April 1885	31st Mar. 1886	Uma Ranganayakulu Naidu	1st April 1885	30th June 1885		
						M. C. Lutchmeepathy Naidu	1st July 1885	31st Mar. 1886.		
	Secunderabad	Ditto	Surgeon-Major G. F. Bevan	1st April 1885	17th June 1885	J. T. Williams	1st April 1885	31st Mar. 1886.		
			,, T. C. H. Spencer	18th June 1885	31st Mar. 1886					
	Kurnool	Ditto	E. C. Johnson, Esq., C.S.	1st April 1885	15th Mar. 1886	G. R. Paramaswara Iyer	1st April 1885	31st May 1885.		
			S. H. Wynne, Esq., B.A., C.S.	16th Mar. 1886	31st Mar. 1886	G. Narayansawmey Naidu	1st June 1885	8th July 1885.		
						S. V. Varadarajullu Naidu	9th July 1885	31st Mar. 1886.		
	Cuddapah	Ditto	Surgeon M. Iyasawmy	1st April 1885	3rd Jan. 1886	V. A. Vijiravalu Moodeliar	1st April 1885	31st Mar. 1886.		
			Asst. Surgeon C. P. Ganapati, L.M.S.	4th Jan. 1886	18th Feb. 1886					
			Surgeon M. Iyasawmy	19th Feb. 1886	31st Mar. 1886					
	Bangalore	Ditto	Surgeon-Major A. F. Dobson, M.B.	1st April 1885	31st March 1886	Rungaswamy Moodeliar	1st April 1885	31st March 1886.		
	Negapatam	Ditto	Surgeon H. St. C. Caruthers	1st April 1885	28th June 1885	S. Saminatha Iyer	1st April 1885	31st March 1886.		
			Surgeon-Major A. H. Leapingwell	29th June 1885	27th Oct. 1885					
			Surgeon T. H. Pope, M.B.	28th Oct. 1885	13th Nov. 1885					
			3rd class Hospital Assistant M. Strenivasa Naidu.	14th Nov. 1885	19th Nov. 1885					
			1st grade Assistant Apothecary H. A. Henderson.	20th Nov. 1885	31st March 1886					
	Salem	Ditto	Surgeon J. Kernan	1st April 1885	26th Oct. 1885	L. Ramsing	1st April 1885	31st March 1886.		
			,, W. F. Thomas	27th Oct. 1885	15th Nov. 1885					
			Assistant Surgeon M. Thummen Singh, M. B.	16th Nov. 1885	31st March 1886					
	Coimbatore	Ditto	Surgeon S. C. Sarkies	1st April 1885	3rd June 1885	Varadia Naidu	1st April 1885	31st May 1885.		
			Surgeon-Major J. F. Fitzpatrick, M.D.	4th June 1885	31st March 1886	C. S. Saminatha Pillay	1st June 1885	31st March 1886.		
	Madura	Ditto	Surgeon F. C. Smith	1st April 1885	31st March 1886	N. E. Kangayan Pillay	1st April 1885	30th April 1885.		
						V. Sashachellum Naidu	1st May 1885	31st May 1885.		
						G. R. Paramaswara Iyer	1st June 1885	31st March 1886.		
	Calicut	Ditto	Captain F. M. Gillham	1st April 1885	31st March 1886	F. D'Rozario	1st April 1885	31st March 1886.		
	Cochin	Ditto	Brigade Surgeon W. H. Morgan	1st April 1885	31st Oct. 1885	M. V. Eippe	1st April 1885	31st March 1886.		
			2nd grade Apothecary O. W. Jones, M.D.	1st Nov. 1885	28th Jan. 1886					
			Brigade Surgeon W. H. Morgan	29th Jan. 1886	31st March 1886					
	Wellington	Ditto	Surgeon-Major W. G. Grant	1st April 1885	10th Dec. 1885	H. Brownsell	1st April 1885	31st March 1886.		
			,, W. Keir	11th Dec. 1885	31st March 1886					

List showing the names of the Superintendents and Observers at the Meteorological Observatories in India, during the year 1885-86—concluded.

Province.	Observatory.	Class.	Names of Superintendents.	Period. From	Period. To	Names of Observers.	Period. From	Period. To
Madras—*concld.*	Mercara	Third	Surgeon-Major Mark Robinson	1st Feb. 1886	31st March 1886	T. S. Arnnachellum Pillay	1st April 1885	22nd July 1885.
						A. M. Venkatasiah	23rd July 1885	31st Dec. 1885.
						Sivaram Moodeliar	1st Jan. 1886	31st Jan. 1886.
						C. Venket Kristnaya	1st Feb. 1886	31st March 1886.
	Mangalore	Ditto	.....	.....	.....	D. T. D'Souza	1st April 1885	8th Oct. 1885.
						S. J. Croning	9th Oct. 1885	31st March 1886.
	Rajahmundry	Ditto	Surgeon-Major E. Levinge	1st April 1885	31st March 1886	A. Mukunda Row Naidu	1st April 1885	31st March 1886.
	Cocanada	Ditto	Port Officer	1st April 1885	31st March 1886	C. J. M. Gaetane	1st April 1885	31st March 1886.
	Rangoon	Second	Surgeon-Major H. Johnstone, M.D.	1st April 1885	31st March 1886	G. E. Wales	1st April 1885	31st March 1886.
						O. White (*Asst.*)	1st April 1885	31st March 1886.
	Bassein	Third	Surgeon S. H. Dantra	1st April 1885	31st March 1886	Moung Pé	1st April 1885	31st March 1886.
	Diamond Island	Ditto	.....	.....	.....	F. W. Marsh	1st April 1885	31st March 1886.
	Akyab	Ditto	.....	.....	.....	Mr. E. B. Atkinson	1st April 1885	31st Dec. 1885.
							11th Feb. 1886	31st March 1886.
						,, M. McSweeny	1st Jan. 1886	10th Feb. 1886.
Burma	Thayetmyo	Ditto	Surgeon W. P. Dalzell	1st April 1885	25th Sept. 1885	Alladeen	1st April 1885	31st March 1886.
			Surgeon-Major J. Backhouse, F.R.C.S.	26th Sept. 1885	31st Dec. 1885			
			Surgeon E. P. Frenchman	1st Jan. 1886	31st March 1886			
	Mergui	Ditto	Mr. P. G. Paul	1st April 1885	13th Feb. 1886	Moosajee	1st April 1885	31st March 1886.
			,, Robert Hall Nailer	14th Feb. 1886	31st March 1886			
	Tounghoo	Ditto	Surgeon Maurice Smith	1st April 1885	10th Nov. 1885	Shaik Hydiat Ally	1st April 1885	31st March 1886.
			Mr. G. B. Fonseca	11th Nov. 1885	9th Dec. 1885			
			Surgeon C. S. Rundle	10th Dec. 1885	31st March 1886			
	Moulmein	Ditto	Brigade Surgeon W F. DeFabeck, M.D.	1st April 1885	22nd Sept. 1885	T. St. Hilbert	1st April 1885	31st March 1886.
			Surgeon R. Ross	23rd Sept. 1885	13th Oct. 1885			
			Surgeon-Major Oswald Baker	14th Oct. 1885	31st March 1886			

BAY ISLANDS	Port Blair	Third	Surgeon-Major W. N. Keefer, M.B.	1st April 1885	10th Oct. 1885	J. T. Peters	1st April 1885	7th Nov. 1885.
						G. T. Carrol	8th Nov. 1885	31st March 1886.
			Surgeon S. F. Bigger, M.B.	11th Oct. 1885	21st Dec. 1885	S. Thomas	1st April 1885	16th April 1885.
			Surgeon-Major W. N. Keefer, M.B.	22nd Dec. 1885	31st March 1886	Shaik Abdool Wahed	17th April 1885	14th May 1885.
	Nancowry	Ditto				Rahmatoollah	15th May 1885	31st Augt. 1885.
						Shaik Madar	1st Sept. 1885	30th Sept. 1885.
						Mahomed Abdool Jubber	1st Oct. 1885	24th Dec. 1885.
						Shaik Kabeeroodeen	25th Dec. 1885	17th March 1886.
						S. Thomas	18th March 1886	31st March 1886.
	Leh	Second	.....	.....	.....	Laskyab	1st April 1885	31st March 1886.
						Hushmut Ali (*Asst.*)	1st April 1885	14th July 1885.
						Haidar Ditto	15th July 1885	31st March 1886.
	Aden	Ditto	Major F. M. Hunter, C.B., C.S.I.	1st April 1885	31st March 1886	W. Abraham	1st April 1885	31st March 1886.
						B. Cordeiro (*Asst.*)	1st April 1885	31st March 1886.
EXTRA INDIAN	Bushire	Third	Lieut.-Col. S. B. Miles	1st April 1885	31st March 1886	Mr. A. Paes	1st April 1885	31st Oct. 1885.
						,, H. M. Cumming	1st Nov. 1885	31st March 1886.
	Quetta	Ditto	Surgeon J. C. Fullerton, M.B.	1st April 1885	31st March 1886	A. Samuel Pillay	1st April 1885	31st March 1886.
	Katmandu	Ditto	.....	.....	.....	Mahomud Hossain	1st April 1885	18th May 1885.
						Pashupat Saran Sinha	19th May 1885	24th June 1885.
	Amini Divi	Ditto	.....	.....	.....	Mahomud Hassain	25th June 1885	31st March 1886.
						Hospital Assistant Syed Laul	1st April 1885	31st March 1886.

APPENDIX D.

Return of the Stock, Receipt and Issue of Instruments for the year 1885-86.

Instruments.	In store on 1st April 1885.	Received, 1885-86.	Issued, 1885-86.
Van Rysselberghe's meteorograph	1	...	1
Barometers, observatory, Fortin's principle	9	10	7
Do. do. Kew principle	6	4	8
Do. mountain, portable tripod (Adie)	20	10	10
Do. marine, Kew principle	21	2	3
Do. Newman's large standard	2	...	...
Do. do. small standard	3	...	...
Do. Negretti and Zambra (various)	7	9	3
Aneroids	18	1	2
Hick's barograph	1	...	...
Thermometers, standard, with attached scales	16	...	7*
Do. do. without attached scales (chemical)	1	...	1
Do. for hygrometers (Kew pattern)	36	14	20
Sling thermometers	7	...	4
Thermometers, maximum, for shade	68	13	26*
Do. solar in vacuo (self-registering)	9	43	35†
Do. do. do. (non-self-registering)	21	...	5
Do. do not in vacuo	2	...	...
Do. minimum, for shade	33	26	31
Do. do. for radiation	14	33	26
Six's thermometers	6	1	...
Traveller's maximum and minimum thermometers	...	6	...
Frankland's sun thermometers	3	1	1
Boiling point thermometers	7	...	...
Thermograph, with Negretti and Zambra's sets of recording thermometers	1	...	...
Common thermometers, brass scales	27	...	1
Ponillet's pyrheliometer	1	...	...
Stewart's actinometer (thermometers for)	7	...	...
Do. do. (chamber for)	1	...	...
Hodgkinson's do.	2	...	...

* 1 condemned as unserviceable.
† 2 do. do.

Return of the Stock, Receipt and Issue of Instruments for the year 1885-86—concluded.

Instruments.	In store on 1st April 1885.	Received, 1885-86.	Issued, 1885-86.
Herschell's actionometer	1	...	...
Regnault's hygrometers	3	...	...
Daniell's do.	10	...	...
Halleur's do.	5	...	...
Pocket spectroscopes (Browning's)	2	...	1
Anemometers	18	16	27
Wind-vanes	...	21	19
Beckley's anemograph	...	1	...
Casella's do.	...	2	...
Electric anemometer and wind-vanes	3	...	...
Rain-gauges (Symons') 5″ diameter	48	10	20
Do. 6″ do.	1	...	...
Self-registering rain-gauge (Casella's)	...	1	...
Measure-glasses for 5″ rain-gauges	8	17	24
Do. do. 6″ do.	2	...	...
Reading lenses	2	2	3
Sun thermometer-stands	4	10	3
Radiation pads	2	2	4
Thermometer cages	3	7	6
Do. do. for ships	14	...	1
Prismatic compasses	1	2	2
Magnetic do.	...	7	...
Sand-glasses (3 minutes)	43	...	26
Sunshine recorders	3	...	2
Bull's-eye lanterns	...	1	1
Salinometers	35	1	36
Clocks	...	9	9
Spirit-level	1	...	...
Electrophorus	1	...	...
Filled tubes for marine Kew principle barometers	12	...	2
Do. do. observatory, do. do. do.	8	12	1
Do. do. Adie's mountain Fortin barometers	...	4	4
Chain for Casella's embossing anemograph	100 ft.	...	100 ft.
Glass cylinder jars	2	...	...

APPENDIX E.

Return of the Instruments issued to each Observatory in 1885-86.

Province.	Stations.	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum thermometer.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer.	Wind-vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sand-glass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Cages.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometer.	Bull's-eye lantern.	Actinometer thermometer.	Nephescope.	Frankland's sun thermometer.	Sunshine recorder.	Salinometer.	Meteorograph.	Spectroscope.	Compass.	Filled tubes for marine K. P. barometer.	Filled tubes for observatory K. P. barometer.	Filled tubes for Adie's mountain Fortin's barometer.
Arabia	Aden	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Beluchistan.	Quetta	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cashmere.	Leh	...	...	...	...	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nepal	Katmandu	2	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Punjab.	Kailang	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mooltan	...	...	1	...	1	1	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Dera Ismail Khan	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Peshawar	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Murree	...	...	...	...	...	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rawalpindi	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sialkot	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Lahore	...	...	...	1	...	...	3*	1	...	...	...	...	2	...	...	...	...	...	...	...	5	...	...	...	...	1	...	...	...	...	...	...	...	...
	Ludhiana	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sirsa	...	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
N.-W. P. and Oudh.	Chakrata	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ranikhet	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pithoragarh	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Meerut	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bareilly	...	...	...	...	...	...	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Agra	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Lucknow	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Gorakhpur	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Allahabad	...	1	1	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...
	Benares	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...
	Ghazipur	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Assam	Tezpur†	1	1	1	1	1	1	1	1	1	1	1	1	1	...	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bengal.	Patna	...	...	...	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Gya	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Hazaribagh	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Burdwan	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Jessore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chittagong	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Demagiri	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Alipore	...	...	1	...	...	...	...	1	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...
	False Point	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Arrah	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

* One non-self-registering.
† Original furnished.

Return of the Instruments issued to each Observatory in 1885-86—continued.

Province.	Stations.	Barometer.	Hygrometer, Dry.	Hygrometer, Wet.	Dry maximum thermometer.	Minimum thermometer, Dry.	Minimum thermometer, Wet.	Radiation thermometer, Solar.	Radiation thermometer, Grass.	Anemometer.	Wind-vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sand-glass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Cages.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometer.	Bull's-eye lantern.	Actinometer thermometer.	Nephescope.	Frankland's sun thermometer.	Sunshine recorder.	Salinometer.	Meteorograph.	Spectroscope.	Compass.	Filled tubes for marine K. P. barometer.	Filled tubes for observatory K. P. barometer.	Filled tubes for Adie's mountain Fortin's barometer.
Bengal.—*concld.*	Balasore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bankoora*	1	1	1	1	1	...	...	...	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bhagulpore	...	1	...	...	...	...	...	...	1	1	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bogra	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Burrisal	...	...	...	2	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chupra	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Furreedpore	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Krishnagar*	2	1	1	2	1	...	...	...	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Maldah*	2	1	1	1	2	...	...	...	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Midnapore	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mymensingh	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Noakhally	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ranchee	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rungpore	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Serajgunge	...	...	...	...	...	...	...	...	2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Central Provinces.	Raipur	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Nagpur	...	...	2	...	...	...	2	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...
	Seoni	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Jubbulpore	...	1	1	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Saugor	...	...	...	...	...	...	2	...	2	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pachmarhi	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Hoshangabad	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Khandwa	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Berar.	Chikalda	...	...	...	...	...	...	...	...	...	...	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Buldana	...	1	1	1	1	...	...	...	1	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Amraoti	...	1	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Akola	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Central India.	Neemuch	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Indore	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Nowgong	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sutna	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Rajputana.	Mount Abu	...	...	...	...	...	...	...	...	1	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bickaneer	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sambhar	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ajmere*	1	1	1	1	1	1	1	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bombay.	Jacobabad	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
	Hyderabad	1	...	...	...	...	...	...	...	1	1	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Kurrachee	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bhuj	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rajkot	...	...	...	...	2	...	...	...	1	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

* Original furniture.

Return of the Instruments issued to each Observatory in 1885-86—concluded.

Province	Stations	Barometer.	Hygrometer. Dry.	Hygrometer. Wet.	Dry maximum thermometer.	Minimum thermometer. Dry.	Minimum thermometer. Wet.	Radiation thermometer. Solar.	Radiation thermometer. Grass.	Anemometer.	Wind-vane.	Rain-gauge.	Measure-glass.	Lens.	Clock.	Sand-glass.	Stand for sun thermometer.	Pad for grass radiation thermometer.	Cages.	Anemograph, Beckley's.	Aneroid.	Standard thermometer.	Sling thermometer.	Bull's-eye lantern.	Actinometer thermometer.	Nephescope.	Frankland's sun thermometer.	Sunshine recorder.	Salinometer.	Meteorograph.	Spectroscope.	Compass.	Filled tubes for marine K. P. barometer.	Filled tubes for observatory K. P. barometer.	Filled tubes for Adie's mountain Fortin's barometer.
Bombay—*concld.*	Deesa	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Surat	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Malegaon	...	...	...	...	...	1	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Poona	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sholapur	...	1	...	...	...	...	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ratnagiri	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Karwar	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Madras and Mysore.	Gopalpore	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Rajahmundry	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Masulipatam	...	...	...	1	...	...	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Secunderabad	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Kurnool	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bellary	...	...	...	...	...	1	1*	1	1	1	1	1	...	...	...	†1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Bangalore	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Cuddapah	2	...	...	1	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Coimbatore	...	...	...	1	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Trichinopoly	...	...	...	...	...	...	1*	...	1	...	...	1	...	...	...	†1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Negapatam	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Madura	...	1	...	2	...	...	1	1	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Burma	Rangoon	...	...	...	...	...	...	1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Toungoo	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Moulmein	1	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Diamond Island	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bay Islands.	Nancowry	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Beluchistan.	Pishin	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	F. L. V. "Star"	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Pilot vessel "Guide"‡	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	F. L. V. "Meteor"	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Cocos Island‡	1	1	1	1	1	1	...	...	1	1	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Forest Dept., Ajmere	...	2	2	1	2	2	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	,, ,, Madras	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	,, ,, Assam	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Afghan Boundary Commission.	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
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* Non-self-regist ring.
† For ditto.

‡ Original furniture.

APPENDIX F.

List of Recipients of the Publications of the Meteorological Office.

Adelaide	Meteorological Observatory.
Agra	The Editor of the *Delhi Gazette*.
Ajmere	Chief Commissioner of Ajmere.
Akola	Sanitary Commissioner for Berar.
Algeria	Director of the Meteorological Service of the École des Sciences d'Alger.
Allahabad	Secretary to the Government, North-Western Provinces and Oudh.
	Department of Revenue and Agriculture, North-Western Provinces and Oudh.
	Meteorological Reporter, North-Western Provinces and Oudh.
	Sanitary Commissioner, ditto ditto.
	Editor of the *Pioneer*.
Amsterdam	Royal Academy of Sciences.
Bangalore	Chief Commissioner, Mysore and Coorg.
	Conservator of Forests, Mysore and Coorg.
Batavia, Java	Meteorological Observatory.
Berlin	Royal Prussian Meteorological Institute.
Bombay	Secretary to the Government of Bombay.
	Meteorological Reporter for Western India.
	Colaba Observatory.
	Sanitary Commissioner with the Government of Bombay.
	Bombay University.
	Asiatic Society of Bombay.
	Sassoon Mechanics' Institute.
	Geographical Society of Bombay.
	Editor of the *Bombay Gazette*.
	Ditto *Times of India*.
	Elphinstone College.
Brisbane, Queensland	Observatory.
Brussels	Royal Academy of Sciences.
	Observatoire Royal.
Bucharest, Roumania	Meteorological Institute.
Budapesth	Observatory.
Calcutta	H. M. Secretary of State for India (through Revenue and Agricultural Department).
	Secretary to the Government of India, Revenue and Agricultural Department.
	Ditto ditto, Home Department.
	Ditto ditto, Public Works Department.
	Ditto ditto, Foreign Department.
	Ditto ditto, Department of Finance and Commerce.
	Ditto ditto, Military Department.
	Private Secretary to His Excellency the Viceroy.
	Secretary to the Government of Bengal, Revenue Department.
	Meteorological Reporter to the Government of Bengal.
	Surveyor General of India.
	Director, Geological Survey of India.
	Sanitary Commissioner with the Government of India.
	Ditto ditto ditto Bengal.
	Superintendent, Botanical Gardens, Calcutta.
	Inspector-General of Forests with the Government of India.
	Surgeon-General ditto ditto.
	Asiatic Society of Bengal.
	Indian Museum Library.
	Calcutta University.
	Presidency College.
	Public Library.
	Editor of the *Calcutta Review*.
	Ditto *Statesman and Friend of India*.

List of Recipients of the Publications of the Meteorological Office—continued.

Calcutta—*concld.*	Editor of the *Englishman.*
	Ditto *Indian Daily News.*
	Ditto *Hindu Patriot.*
	Ditto *Indian Agriculturist.*
	St. Xavier's College Observatory.
	The Alipore Observatory.
	Mint Master.
	Indian Association for the Cultivation of Science.
Cambridge	University Library (through H. M.'s Secretary of State for India).
Cambridge, Massachusetts	Harvard University.
Cape of Good Hope	Astronomer Royal.
Carlsruhe, Baden, Germany	Bureau für Meteorologie und Hydrographie.
Chemnitz	Royal Meteorological Institute.
Chatham	Royal Engineers' Library (through Revenue and Agricultural Department).
Christiania	Norske Meteorologiske Institut.
	Royal Observatory.
Colombo	Editor of the *Ceylon Times.*
	Ditto *Ceylon Observer.*
	Surveyor General of Ceylon.
Constantinople	Observatoire Impérial Météorologique.
Copenhagen	Danske Meteorologiske Institut.
	Royal Danish Academy of Sciences.
Cordoba	Meteorological Office.
	National Academy of Science.
Darjeeling	Conservator of Forests, Government of Bengal.
Dehra Dun	Editor of the *Indian Forester.*
	Superintendent, Great Trigonometrical Survey.
Dharwar	Conservator of Forests, Bombay, Southern Division.
Dublin	Royal Dublin Society.
Dacca	Dacca College.
Edinburgh	Scottish Meteorological Society.
	Astronomer Royal for Scotland, Royal Observatory.
	Scottish Geographical Society (through H. M.'s Secretary of State for India).
Ellichpore	Assistant Conservator of Forests, Melghat Division.
Goa	Royal Observatory.
Greenwich	Astronomer Royal, Royal Observatory.
Guatemala	Observatorio Meteorologico del Institut Nacional de Guatemala.
Hamburgh	Nord Deutsche Seewarte.
	Deutsche Meteorologische Gessellschaft.
Havana	Real Collegio de Belen.
Hong-Kong	Observatory.
Indore	Agent to the Governor General for Central India in charge of the Residency.
Iowa, U. S.	Iowa Weather Service.
Jeypore	Maharajah's Observatory.
Jubbulpore	Civil Surgeon of Jubbulpore.
Katmandu	Resident at Nepal.
Khandwa	Civil Surgeon of Nimar.
Kitzingen, Bavaria	Dr. Emil Von Schlagintweit.
Kurrachee	Conservator of Forests, Bombay, Sind Division.
Lahore	Secretary to the Government of the Punjab.
	Meteorological Reporter ditto ditto.
	Sanitary Commissioner ditto ditto.
	Conservator of Forests ditto ditto.
	Editor of the *Indian Public Opinion.*
Leeds	Yorkshire College (through H. M.'s Secretary of State for India).
Lisbon	Observatoire de Infante d'Luiz.
	Academy of Sciences.
London	Meteorological Council.
	Royal Society.
	Royal Asiatic Society (through H. M.'s Secretary of State for India).
	Northbrook Indian Club (through H. M.'s Secretary of State for India).

List of Recipients of the Publications of the Meteorological Office—continued.

London—*concld.*	Society of Arts.
	Institution of Civil Engineers.
	Royal School of Mines.
	Royal Meteorological Society.
	Admiralty Library.
	United Service Museum.
	British Museum (through H. M.'s Secretary of State for India).
	Athenæum Club.
	Editor of the *Philosophical Magazine.*
	Ditto *Athenæum.*
	Ditto *Nature.*
	Ditto *Symons's Monthly Meteorological Magazine.*
	Ditto *Westminster Review.*
	Ditto *Quarterly Review.*
Madras	Secretary to the Government of Madras.
	Ditto ditto Public Works Department.
	Meteorological Reporter to the Government of Madras.
	Government Astronomer, Madras.
	Sanitary Commissioner, Government of Madras.
	Madras University.
	Editor of the *Madras Times.*
	Ditto *Madras Mail.*
	Superintendent, Government Central Museum.
	Assistant Director of Agriculture, Government of Madras.
	Surgeon General, British Medical Department.
	Ditto, Indian Medical Department.
	Master Attendant of Madras.
	Conservator of Forests, Northern Circle.
Madrid	Royal Observatory.
Magdeburgh	Observatory of the Magdeburgh Zeitung.
Manchester	Literary and Philosophical Society.
Manila	Meteorological Observatory.
Mauritius	Meteorological Society.
Melbourne, Victoria	Observatory.
	University Library.
	Public Library.
Mexico	Central Meteorological Observatory.
Milan	Royal Astronomical Observatory.
Munich	Royal Observatory.
	Royal Bavarian Academy of Sciences.
	Geographical Society.
Nagpur	Chief Commissioner, Central Provinces.
	Sanitary Commissioner, ditto.
	Inspector General of Education, Central Provinces.
	Superintendent, Meteorological Observatory.
	Conservator of Forests, Central Provinces.
Naini Tal	Ditto ditto, North-Western Provinces and Oudh.
New Haven, Connecticut	Connecticut Academy of Arts and Sciences.
	Editors of the *American Journal of Science.*
New York, U. S.	Central Park Observatory.
Nowgong-Rajshahye	Sub-Divisional Officer.
Ootacamund	Conservator of Forests, Government of Madras.
	Editor of the *South of India Observer.*
Oxford	Radcliffe Library.
	Radcliffe Observatory.
Paris	Observatoire Physique Central de Montsouris.
	Editor of *La Nature.*
	Physical Observatory, Meudon.
	Bureau Central Météorologique.
	Meteorological Society of France.
Perpignan, France	Observatorie Météorologique et Magnetique.

List of Recipients of the Publications of the Meteorological Office—concluded

Perth, W. Australia	Surveyor General.
Pesaro, Italy	Royal Observatory.
Philadelphia	Franklin Institute.
Poona	Conservator of Forests, Bombay, Northern Division.
Prag, Bohemia	Observatory.
Raipur	Civil Surgeon of Raipur.
Rangoon	Chief Commissioner, Burma.
	Sanitary Commissioner, ditto.
	Conservator of Forests, ditto.
	Editor of the *Rangoon Times*.
Rome	Meteorological Office (Ministry of Agriculture).
Rio de Janeiro	Imperial Observatory.
Saharunpore	Superintendent, Botanic Gardens.
Secunderabad	Secretary to the Resident at Hyderabad.
Shillong	Chief Commissioner of Assam.
	Conservator of Forests, Assam.
Simla	Assistant Quarter Master General, Intelligence Branch.
Singapore	Principal Civil Medical Officer, Straits Settlements.
Stockholm	Nautisk Meteorologiska Byran.
St. Petersburg	Observatoire Physique Central.
	Geographical Society of Russia.
	Prof. H. Wild, Central Physical Observatory.
Strasburg	Imperial University Library.
Stonyhurst	Stonyhurst College Observatory.
Sydney	Observatory.
	University Library.
Syracuse, Sicily	Royal Meteorological Observatory.
Tasmania	Royal Society.
Tiflis, Russia	Physical Observatory.
Tokei, Japan	Imperial Mining Office.
	Imperial Meteorological Observatory.
Toronto, Canada	Magnetical and Meteorological Observatory.
Turin	Royal Astronomical Observatory.
	Meteorological Society of Italy.
Upsala	Meteorological Observatory.
Utrecht	Royal Netherlands Meteorological Institute.
Vienna	K.K. Central-Anstalt für Meteorologie und Erdmagnetismus.
	K.K. Geologische Reichsanstalt.
	Imperial Academy of Sciences.
	Dr. J. Hann.
Vizagapatam	A. V. Nursingrow, Esquire.
Washington, U. S.	Chief Signal Officer, United States Army.
	Smithsonian Institution.
	Naval Observatory.
	Hydrographic Office.
	Professor Cleveland Abbe, Signal Office.
	United States Geological Survey.
Wellington, New Zealand	Observatory.
Woolwich	Royal Artillery Library.
Zi-ka-wei, Shanghai	Magnetical and Meteorological Observatory.
Zurich	Central Meteorological Institute.

APPENDIX G.

Presentations to the Library from the 1st April 1885 to the 31st March 1886.

Place.	Donors.	Title of work.
ALGIERS	Meteorological Service	Bulletin Météorologique du Gouvernement général de l'Algérie, 16th February 1885 to 15th February 1886.
		Bulletin Mensuel, December 1884, and February to June 1885.
ALLAHABAD	Meteorological Office	Administration Report of the Meteorological Reporter to the Government of the North-Western Provinces and Oudh for the year 1884-85.
		Sketch of the Meteorology of the year 1884 in the North-Western Provinces and Eastern Rajputana.
AMSTERDAM	Royal Academy of Sciences	Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschapen Afd Natuurkunde, Tweede Reeks, Deels XIX and XX.
		Processen verbaal, 1883-84.
		Naam en zaakregester op Akad, &c., Tweede Reeks, Deel I—XX.
		Jaarboek, 1883.
BATAVIA	Magnetical and Meteorological Observatory.	Rainfall in the East Indian Archipelago, sixth year, 1884.
		Observations made at the Magnetical and Meteorological Observatory in Batavia, Vol. VI, parts I and II.
BERLIN	Austrian and German Meteorological Society.	Meteorologische Zeitschrift, January and February 1886.
	Dr. G. Hellman	Ueber gewisse Gesetzmässigkeiten im Wechsel der Witterung aufeinanderfolgender Jahreszeiten.
	Royal Prussian Statistical Bureau	Preussische Statistik-Ergebnisse der Meteorologischen Beobachtungen im Jahre 1884.
BOMBAY	Government of Bombay	Annual Report of the Sanitary Commissioner for the Government of Bombay for 1884.
		Bombay Gazetteer, Vol. XVIII, parts I to III.
	Government Observatory	Magnetical and Meteorological observations made at the Government observatory, Bombay, during the years 1883 and 1884.
	Meteorological Office	Brief sketch of the Meteorology of the Bombay Presidency in 1883-84.
BOSTON	Reception Committee	Addresses at the Complimentary dinner to Dr. Benjamin Apthorp Gould.
BRUSSELS	Royal Academy of Sciences	Bulletin, 3rd series, Tomes VI to VIII.
		Annuaire, 1884 and 1885.
		Jours de solitude.
BUCHAREST	Institutul Meteorological Romaniei	Buletinul Ministerului agriculturei, industreii, comercilui si domenütor, Anul I, 1885, Nos. 2 to 7.
BUDAPESTH	K. Central Anstalt für Meteologie und Erdmagnetismus.	Jahrbücher. Bände X to XIV.
CALCUTTA	Comptroller and Auditor General	Civil Budget Estimate for the year 1885-86.
	Director-General of Post Offices in India.	Indian Postal Guide, No. XXV, October 1885.
	Geological Survey of India	Memoirs of the Geological Survey of India, Vol. XXI, parts 3 and 4.
		Records of the Geological Survey of India, Vol. XVIII, parts 2 to 4; Vol. XIX, part I.
	Government of Bengal	Returns of the rail-borne traffic of Bengal during the quarters ending 31st March 1884, and 31st March, 30th June and 30th September 1885.
		Report on the external trade of Bengal with Nepal, Sikkim, and Bhutan for 1884-85.
		Report on the rail-borne traffic of Bengal during the year 1884-85.
		Report on the river-borne traffic of the lower provinces of Bengal and on the inland trade of Calcutta and on the trade of Chittagong and the Orissa ports for the year 1884-85.

Presentations to the Library from the 1st April 1885 to the 31st March 1886—continued.

Place.	Donors.	Title of Work.
CALCUTTA—*concld.*	Government of India, Home Department	Report of the Meteorological Council to the Royal Society for the year ending 31st March 1884.
		Forest Department; Code of Instructions.
	Government of India, Revenue and Agricultural Department	Appendix to the Report of the Indian Famine Commission, Vol. VI.
		Report of the Indian Famine Commission, Part III, Famine Histories.
		Official Report of the Calcutta International Exhibition, 1883-84, Vols. I and II.
		Administration Report on the Madras Observatory for the year 1884.
	Henry F. Blanford, F.R.S.	Connexion of the Himalayan snowfall with dry winds and seasons of drought in India. (Pamphlet.)
	Meteorological Office, Bengal	Administration Report of the Meteorological Reporter to the Government of Bengal for 1884-85.
	Sanitary Commissioner with the Government of India	Annual Report of the Sanitary Commissioner with the Government of India for 1884.
	St. Xavier's College Observatory	Meteorological observations recorded at the St. Xavier's College Observatory, July 1884 to December 1885.
	Surveyor General of India	General Report on the operations of the Survey of India Department during 1883-84.
CAMBRIDGE	University	Twenty-first Annual Report of the Library Syndicate.
CAPODIMONTI (NAPLES).	Astronomical observatory	Recerche Numerichi sulla latitudini del R. Osservatorio di capodimonti, part I.
CARLSRUHE	Bureau für Meteorologie und Hydrographie, Baden	Jahres-Bericht für das Jahr 1884.
		Beiträge zur Hydrographie des Grossherzogthums Baden, Zweites Heft.
CHRISTIANIA	Norwegian Meteorological Institute	Jahrbücher für 1881, 1882, and 1884.
COLOMBO	Surveyor General of Ceylon	Administration Report, 1884 (Part III, Scientific) Meteorology.
COPENHAGEN	Institut Météorologique Danois	Bulletin Météorologique du Nord, February 1885 to January 1886.
	Royal Academy of Sciences	Oversigt, No. 3 of 1884 and Nos. 1 and 2 of 1885.
CORDOBA	National Academy of Sciences	Boletin de la Academia Nacional de Ciencias en Cordoba (Republica Argentina), Tomo VII, Entrega 3a and 4a; Tomo VIII, Entrega, 1a.
		Anales de la officina Meteorologica Argentina, Tomo IV.
		Actas de la Academia Nacional de Ciencias en Cordoba, Tomo V, entrega segunda.
	Oficina Meteorologica Argentina	Informes Annales y documentus.
DEHRA DUN	Editor, Indian Forester	Indian Forester, April 1885 to March 1886.
	Trigonometrical Branch, Survey of India	Spirit-levelled heights in the Thana, Nasik, and Khandesh districts of Bombay, and in Dhar, Dewas, Gwalior, Bhopal and Tonk Native States of the Central India Agency.
DORPAT	Meteorological Observatory	Anemometrische Scalen für Dorpat.
DUBLIN	Royal Dublin Society	Scientific proceedings, Vol. III, New series, Parts 5 to 7; Vol. IV, New series, Parts 1 to 6.
		Scientific Transactions, series II, Vol. I, Nos. 15 to 25; Vol. II, Nos. 2-3; Vol. III, Nos. 1 to 6.
EDINBURGH	Scottish Meteorological Society	Journal, 3rd series, No. II.
GREENWICH	Magnetical and Meteorological Observatory.	Greenwich Magnetical and Meteorological Observations for 1883.
HAMBURGH	Deutsche Meteorologische Gesellschaft.	Meteorologische Zeitschrift, February to December 1885.
	Deutsche Seewarte	Meteorologische Beobachtungen in Deutschland für 1877, 1878, and 1882.
		Monatliche Uebersicht der Witterung, July to December 1884 and the year 1884; January to April 1885.
		Wetterbericht, Vol. X, Nos. 60 to 365; Vol. XI, Nos. 1 to 31.
		Aus den Archiv der Deutschen Seewarte, 1882 and 1883.

ons to the Library from the 1st April 1885 to the 31st March 1886—continued.

	Donors.	Title of Work.
	Real Colegio de Belen	Observaciones Magneticas y Meteorologicas, January to June 1876; January to June 1885.
	Observatory	Lunar-Transits across the meridian of Hongkong.
		Report on the height of Victoria Peak.
		Five-day means of the principal meteorological elements for 1884.
		Annual Weather Report for 1884.
		Notice to mariners of the signs of approaching Typhoons.
		Weather Report for August 1884 to November 1885.
		Progressive motion of Typhoons in 1884.
		Observations and Researches made at the Hongkong Observatory in the year 1884.
	Weather Service	Report of the Iowa Weather Service for September 1881 to December 1882.
		Third Biennial Report of the central station of the Iowa weather service.
		The seasons in Iowa and a calendar for 1884.
		Bulletin of the Iowa Weather Service, January to May 1883.
FYPORE	Dr. T. H. Hendley	Annual Report of the Jeypore medical and meteorological institutions for 1884.
	Government of the Punjab	Report of the Land Revenue Settlement of the Dera Ismail Khan District, 1877 to 1879.
		Volume of maps to accompany the Dera Ismail Khan Settlement Report.
AHORE		Report on the Land Revenue Settlement of the Bannu District, 1872 to 1878.
		Volume of maps connected with the Settlement Report of the Bannu District.
	Meteorological Office	Report on the Meteorology of the Punjab for 1884-1885.
	Augustus Tischner	The fixed idea of astronomical theory.
PZIG	Meteorological Institute	Jahrbuch, 1884.
	G. J. Symons, Esq.	Symons's Monthly Meteorological Magazine, February 1885 to February 1886.
	John A. R. Newlands	The discovery of the periodic law and the relations among the atomic weights.
	Meteorological Office	Principles of forecasting by means of weather charts.
		Quarterly Weather Report, Parts I to IV of 1877.
		Weekly Weather Report, New Series, Vol. I, Nos. 44 to 52; Vol. II, Nos. 1 to 46.
		Monthly Weather Report, November 1884 to August 1885.
		Hourly readings, Part IV of 1882; Parts I and II of 1883.
		Meteorological observations at stations of the second order for the year 1880.
		Report of the Meteorological Council to the Royal Society for the year ending March 1884.
		Daily Weather Report, 1st July to 31st December 1884; 1st January to 30th June 1885.
		Contributions to our knowledge of the Meteorology of the Arctic regions, Part IV.
	Royal Asiatic Society	Journal, Vols. X, XVII, and XVIII, part I.
	Royal Meteorological Society	List of Fellows of the Royal Meteorological Society, 1st February 1885.
		The Meteorological Record, Nos. XV to XVIII.
		Quarterly Journal, New Series, Vol. XI, Nos. 53 to 56.
	Royal Society	Proceedings, Vol. XXXVII, Nos. 233 and 234; Vol. XXXVIII, Nos. 235 to 239.

Presentations to the Library from the 1st April 1885 to the 31st March 1886.

Place.	Donors.	Title of Work.
LONDON—*concld.*	Society of Arts	Journal, Nos. 1686 to 1737.
		Index to Journal, Vols. I to X and XI to XX.
	Solar Physics Committee	Dates of coincidence of the assumed prime meridian central meridian of the visible hemisphere.
MADRAS	Government Astronomer	Madras magnetical observations, 1851 to 1855.
		Singapore magnetical observations, 1841 to 1845.
		Telegraphic longitude determination in India.
	Government of Madras	Annual Administration Report of the Forest Department Northern Circles), Madras Presidency, for the year 1883-84.
	Meteorological Office	Administration Report of the Meteorological Reporter to the Go Madras for 1884-85.
MADRID	Royal Observatory	Anuario, Ano XVIII, 1880.
		Observaciones meteorologicas, 1879 to 1881.
		Resumen de las observaciones meteorologicas de provincias, 1876 to 1
MANCHESTER	Literary and Philosophical Society	Memoirs of the Literary and Philosophical Society, 3rd series, Vol. VII
		Proceedings, Vols. XXIII and XXIV.
MAURITIUS	Royal Alfred Observatory	Mauritius meteorological results for 1882 and 1883.
MELBOURNE	Observatory	Monthly record of results of observations in Meteorology, Terrestria Magnetism, &c., taken at the Melbourne Observatory from October 188 to October 1885.
MEXICO	Central Meteorological Observatory	Boletin del Ministerio de Fomento de la Republica Mexicana, Tomo IX, Nos. 65 to 80; Tomo X, Nos. 1—36, 43—113.
		Resumen comparativo correspondiente a les Anos de 1877—1884.
		Estudios de meteorologiá comparada, Tomo I.
MILAN	R. Osservatorio di Brera	Sui tempora.i osservati nell Italia superiore durante l'Anno 1879.
MONCALIERE	Central Observatory	Osservazione delle meteore luminose nell' Anno 1884 and 1885.
MUNICH	Geographical Society	Jahresbericht für 1884.
	Royal Bavarian Academy of Sciences.	Astronomisch-geodätische Bestimmungen, ausgeführt an einigen Ha punkten des Bayerischen Dreiecksnetzes.
		Nachträge zu den zonenbeobachtungen der Sternwarte bei Munchen.
		Sitzungsberichte der mathematisch physicalischen class, Hefte II to IV 1884; Heft I of 1885.
		Abhandlungen der mathematisch physicalischen classe, Band X, pa and II.
NAGPUR	Chief Commissioner, Central Provinces.	Returns of rail-borne traffic during the quarters ending 31st December 1 and 31st March, 30th June and 30th September 1885.
		Report on the Nagpur Experimental Farm in the Central Provinces for year 1884-85.
		Report on the railway-borne traffic of the Central Province
		Forecast of linseed crop in 1886 in the Central Provinces.
		Forecast of wheat crop in 1886 in the Central Provinces.
		Review of the Agriculture and Revenue Reports of the Centr the year 1884-85.
NEW HAVEN	Connecticut Academy of Arts and Sciences.	Transactions, Vol. VI, part 2.
NEW YORK	Meteorological Observatory	Abstract of registers from self-recording instruments, December 1884 and January to November 1885.
		Annual Report for 1884.
OXFORD	Radcliffe Observatory	Results of meteorological observations made at the Radcliffe Observatory, Oxford, in the year 1882.

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